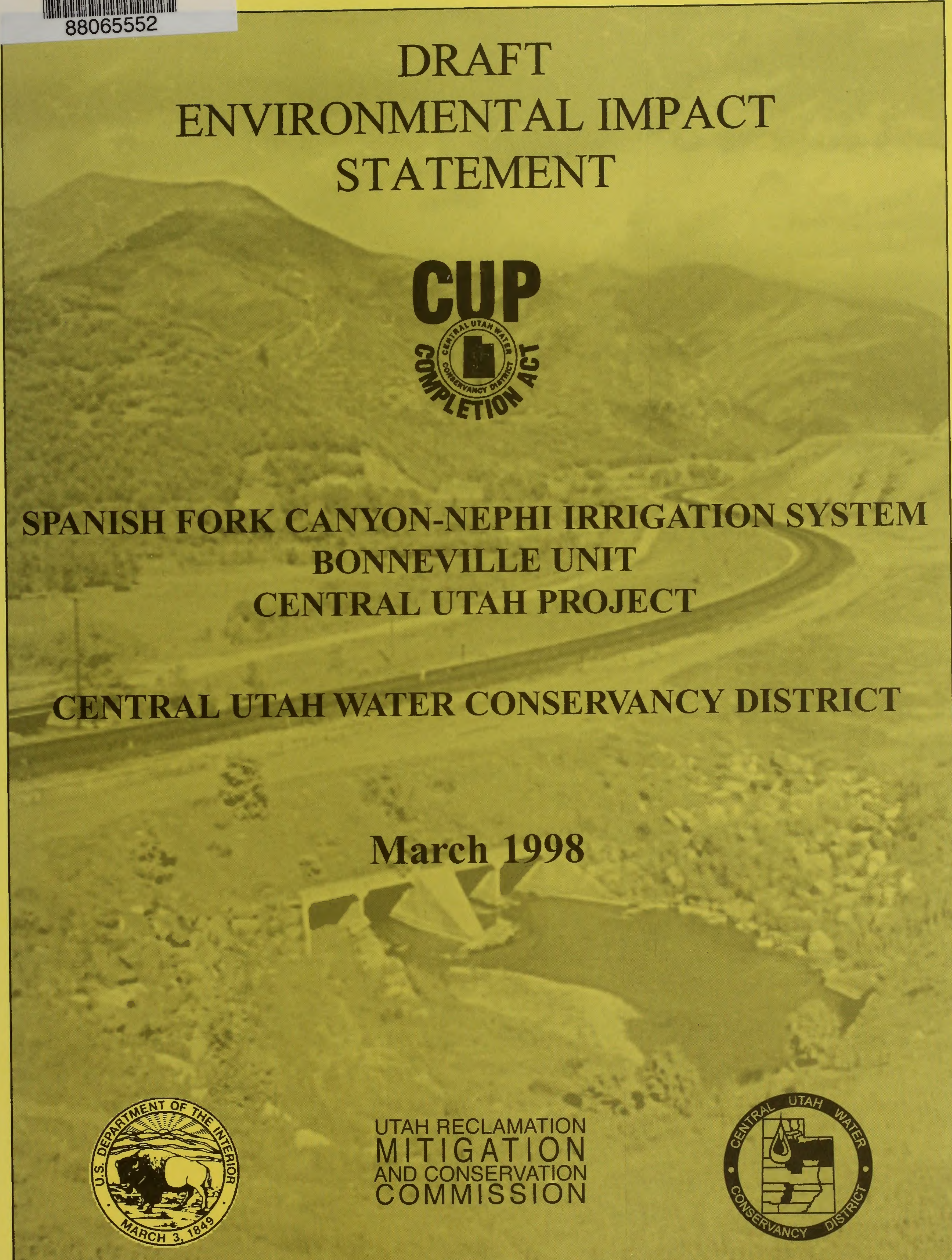

DRAFT ENVIRONMENTAL IMPACT STATEMENT

CUP
CENTRAL UTAH WATER CONSERVANCY DISTRICT
COMPLETION ACT

SPANISH FORK CANYON-NEPHI IRRIGATION SYSTEM
BONNEVILLE UNIT
CENTRAL UTAH PROJECT

CENTRAL UTAH WATER CONSERVANCY DISTRICT

March 1998

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

UTAH RECLAMATION
MITIGATION
AND CONSERVATION
COMMISSION

CENTRAL UTAH WATER CONSERVANCY DISTRICT

March 31, 1998

Dear Reviewer:

This Draft Environmental Impact Statement (DEIS) prepared for Spanish Fork Canyon - Nephi Irrigation System (SFN System) was filed with EPA on March 31, 1998 and is submitted for your review and comment. The purpose of this public review is to receive your comments on the information presented in this DEIS. A Final Environmental Impact Statement (FEIS) will be prepared considering the comments received and will be sent to those who have commented on the DEIS or who request a copy. The FEIS may only include errata sheets and responses to comments; therefore, you should retain your copy of this DEIS.

Please submit your written comments to the address below so that they are received by June 15, 1998. Comments received by this date will be responded to in the FEIS. Please make your comments as specific as possible and provide rationale or data to support your position. Comments will be most helpful if they address inadequacies in the impact analysis or methodologies.

Written comments regarding the SFN System DEIS should be addressed to:

Sheldon H. Talbot, Project Manager
Central Utah Water Conservancy District
335 West University Parkway
Orem, Utah 84058-7303

Comments on the DEIS also may be presented orally or submitted in writing at a public hearing. Public hearings have been scheduled for the following dates and locations:

May 11, 1998
6:30 p.m.
Salt Lake County Commission Chambers
2001 South State Street, Room N1100
Salt Lake City, Utah

May 12, 1998
6:30 p.m.
Santaquin City Seniors Center
65 West 100 South
Santaquin, Utah

If you wish to provide oral comments at the hearing, please fill out a hearing registration form (included at the end of the DEIS) and return it to our Orem office at the address listed below.

Please send hearing registration forms to: Nancy Hardman, CUWCD 355 West University Parkway, Orem, Utah 84058 Phone: (801) 226-7187 or FAX (801) 226-7150.

Sincerely,

Sheldon H. Talbot

Sheldon H. Talbot, Project Manager
Central Utah Water Conservancy District

CENTRAL UTAH
WATER CONSERVANCY DISTRICT

SPANISH FORK CANYON-NEPHI IRRIGATION SYSTEM
BONNEVILLE UNIT
CENTRAL UTAH PROJECT

DRAFT
ENVIRONMENTAL IMPACT
STATEMENT

MARCH 1998

U.S. DEPARTMENT OF THE INTERIOR

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SPANISH FORK CANYON - NEPHI IRRIGATION SYSTEM

Prepared by
Central Utah Water Conservancy District
March 1998

Don A. Christiansen, General Manager
Central Utah Water Conservancy District

Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission

Ronald Johnston, CUPCA Program Director
U.S. Department of the Interior

Cover Sheet

Spanish Fork Canyon - Nephi Irrigation System (SFN System)
Draft Environmental Impact Statement

Joint Lead Agencies

Central Utah Water Conservancy District
Utah Reclamation Mitigation and Conservation Commission
U.S. Department of the Interior

Cooperating Agencies

U.S. Army, Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S.D.A. Natural Resources Conservation Service
U.S.D.A. Forest Service
Utah Department of Natural Resources
Strawberry Water Users Association
East Juab County Water Conservancy District
Utah Outdoor Interest Coordinating Council

Counties that Could be Affected Utah, Juab, and Salt Lake - Utah

Abstract

Water conveyance facilities are needed to 1) deliver transbasin Bonneville Unit supplemental irrigation water to southern Utah and eastern Juab Counties, 2) deliver transbasin Bonneville Unit M&I water to Utah Lake in exchange for M&I water developed from groundwater and springs in southern Utah County, and 3) deliver water to Utah Lake for exchange to Jordanelle Reservoir for delivery in Summit, Wasatch, Utah and Salt Lake Counties. The facilities under the Proposed Action would consist of features of the Diamond Fork System to form the hydraulic connection between the completed Diamond Fork System facilities, and the Main Conveyance Aqueduct to convey the water from the end of the Diamond Fork System to southern Utah and eastern Juab Counties. Six alternatives to the Proposed Action, including a "No Action" Alternative, are addressed in this DEIS. This DEIS contains a comparative analysis of the Proposed Action and alternatives. In addition, this DEIS includes an analysis of potential environmental impacts that had been deferred from previous environmental documents prepared for Bonneville Unit systems. Specifically, the deferred Bonneville Unit analysis includes potential impacts on Utah Lake, Jordan River, Great Salt Lake, and Colorado River fish from the operation of the Bonneville Unit.

Other Requirements Served

This DEIS is intended to serve other environmental review and consultation requirements pursuant to 40 CFR 1502.25 (a).

Comments on this DEIS should be directed to:

Sheldon H. Talbot, Project Manager
Central Utah Water Conservancy District
355 West University Parkway
Orem, Utah 84058

Date DEIS Made Available to EPA and the Public: **March 31, 1998**

Date by Which Comments on the DEIS Must be Received to be Considered in the Preparation of the Final Environmental Impact Statement: **June 15, 1998**

Preface

This Spanish Fork Canyon - Nephi Irrigation System (SFN System) Draft Environmental Impact Statement (DEIS) was prepared by the Central Utah Water Conservancy District (CUWCD), pursuant to the Central Utah Project Completion Act (CUPCA) Public Law 102-575, of 1992. Assistance was provided by the U.S. Department of Interior (DOI) and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission).

This DEIS has a Signature Page, Cover Sheet, Table of Contents, Summary, and six chapters.

Chapter 1	-	Describes the Proposed Action and alternatives, including the purpose and need.
Chapter 2	-	Presents a comparative analysis of the Proposed Action and alternatives and an analysis of deferred Bonneville Unit impacts.
Chapter 3	-	Describes the affected environment and environmental consequences of the Proposed Action and alternatives.
Chapter 4	-	Describes the consultation and coordination performed by the CUWCD throughout the environmental analysis and preparation of this DEIS.
Chapter 5	-	Describes the short-term use of man's environment versus maintenance of long-term productivity of the SFN System.
Chapter 6	-	Describes the irreversible and irretrievable commitment of resources required for the SFN System.

The References Cited, Glossary, and Abbreviations and Acronyms follow Chapter 6. Appendices follow the Abbreviations and Acronyms section. Tables, figures and maps are contained within the DEIS and are referenced as necessary.

Copies of this document are available for public review at the DOI office at 302 East 1860 South, Provo, Utah; Utah Reclamation Mitigation & Conservation Commission office at 102 West 500 South, Suite 315, Salt Lake City, Utah; CUWCD office at 355 West University Parkway, Orem, Utah; and public libraries in Spanish Fork, Nephi, Provo, Orem, and Salt Lake City, Utah. Copies of this DEIS have also been distributed to university and college libraries throughout the CUWCD service area. A complete list of agencies and groups receiving the DEIS is included in Appendix E of this document.

Copies of this DEIS may be requested from the following address:

Nancy Hardman
Central Utah Water Conservancy District
355 West University Parkway
Orem, Utah 84058
Telephone: (801) 226-7187
Fax: (801) 226-7150

Preface

The Spanish Fork Canyon - Nephi Irrigation System (SFN System) Final Environmental Impact Statement (FEIS) was prepared by the Central Utah Water Conservancy District (CUWCD), pursuant to the Central Utah Project Completion Act (CUPCA) Public Law 102-575, of 1992. Assistance was provided by the U.S. Department of Interior (DOI) and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission).

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Chapter 5	-	Describes the short-term use of man's environment versus maintenance of long-term productivity of the SFN System.
Chapter 6	-	Lists the preparers of the FEIS, and includes a list of individuals responsible for the SFN System.

The References Cited, Glossary, and Abbreviations and Acronyms follow Chapter 6. Appendices follow the Abbreviations and Acronyms section. Most tables and maps are contained within the FEIS and are referenced as necessary.

Copies of this document are available for public review at the DOI office at 302 East 1860 South, Provo, Utah; the Utah Reclamation Mitigation and Conservation Commission office at 102 West 500 South, Suite 315, Salt Lake City, Utah; CUWCD office at 355 West University Parkway, Orem, Utah; and public libraries in Spanish Fork, Nephi, Provo, Orem and Salt Lake City, Utah. Copies of the DEIS have also been distributed to university and college libraries throughout the CUWCD service area. A complete list of agencies and groups receiving the DEIS is included in Appendix E of this document.

Copies of this FEIS may be requested from the following address:

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SPANISH FORK CANYON-NEPHI IRRIGATION SYSTEM
DRAFT ENVIRONMENTAL IMPACT STATEMENT

SUMMARY

Summary

S.1 Introduction

The Central Utah Water Conservancy District (CUWCD), the U.S. Department of Interior (DOI), and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) have prepared this Draft Environmental Impact Statement (DEIS) to assess the environmental effects related to the construction and operation of the proposed Spanish Fork Canyon-Nephi Irrigation System (SFN System). The SFN System is one of the systems of the Bonneville Unit of the Central Utah Project (CUP), which develops Utah's water resources for irrigation, municipal and industrial (M&I), fish and wildlife, and recreational use.

The action alternatives of the SFN System would deliver water for irrigation and M&I uses in southern Utah County and eastern Juab County, extending as far south as the Nephi area. In addition to the discussion of the SFN System environmental impacts, proposed changes in the design of facilities and operation of the Diamond Fork System are also addressed in this DEIS. The two systems are interdependent in layout and operation, and in the time since earlier National Environmental Policy Act (NEPA) documents associated with the Diamond Fork System (USBR 1984, 1990) were completed, the components and operation of the Diamond Fork System have changed.

This DEIS has been prepared pursuant to the requirements of NEPA. This DEIS is intended to satisfy the NEPA disclosure requirements and will be used by the CUWCD, DOI, and the Mitigation Commission, in conjunction with other relevant material, to plan activities and make decisions. In addition, this DEIS will serve as a NEPA compliance document for the various contracts and agreements that will be negotiated to cover the construction and operation of the SFN System. This DEIS fulfills certain commitments for studies made in the earlier NEPA documents such as the *Bonneville Unit Final EIS* (USBR 1973) and the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990).

S.1.1 Background

On October 30, 1992, the Central Utah Project Completion Act (CUPCA) was signed into law by the President of the United States. CUPCA authorized the CUWCD to plan, design, and construct the remaining Bonneville Unit features and authorized various mitigation and enhancement measures to compensate for past development and to enhance wildlife habitat.

The Bonneville Unit of the CUP is located in central and northeastern Utah. The unit includes facilities to develop and more fully utilize waters tributary to the Duchesne River in the Uinta Basin of Utah, to facilitate a transbasin diversion from the Colorado River Basin to the Bonneville Basin, and to develop and distribute project water in the Bonneville Basin. For planning and coordination purposes, the Bonneville Unit was originally divided into six systems according to location and function: 1) the Starvation Collection System, 2) the Strawberry Collection System, 3) the Ute Indian Tribal Development, 4) the Diamond Fork System, 5) the Municipal and Industrial System (M&I System), and 6) the Irrigation and Drainage System (I&D System). While the I&D System was reauthorized in CUPCA, the CUWCD developed an alternative delivery system, authorized by Section 202(a)(1) of CUPCA, now termed the SFN System, which would convey water only within the Utah Lake drainage basin.

S.1.2 Purpose and Need of the SFN System

Water conveyance facilities are needed to 1) deliver transbasin Bonneville Unit supplemental irrigation water to southern Utah and eastern Juab Counties, 2) deliver transbasin Bonneville Unit M&I water to Utah Lake in

exchange for M&I water developed from groundwater and springs in southern Utah County, and 3) deliver water to Utah Lake for exchange to Jordanelle Reservoir.

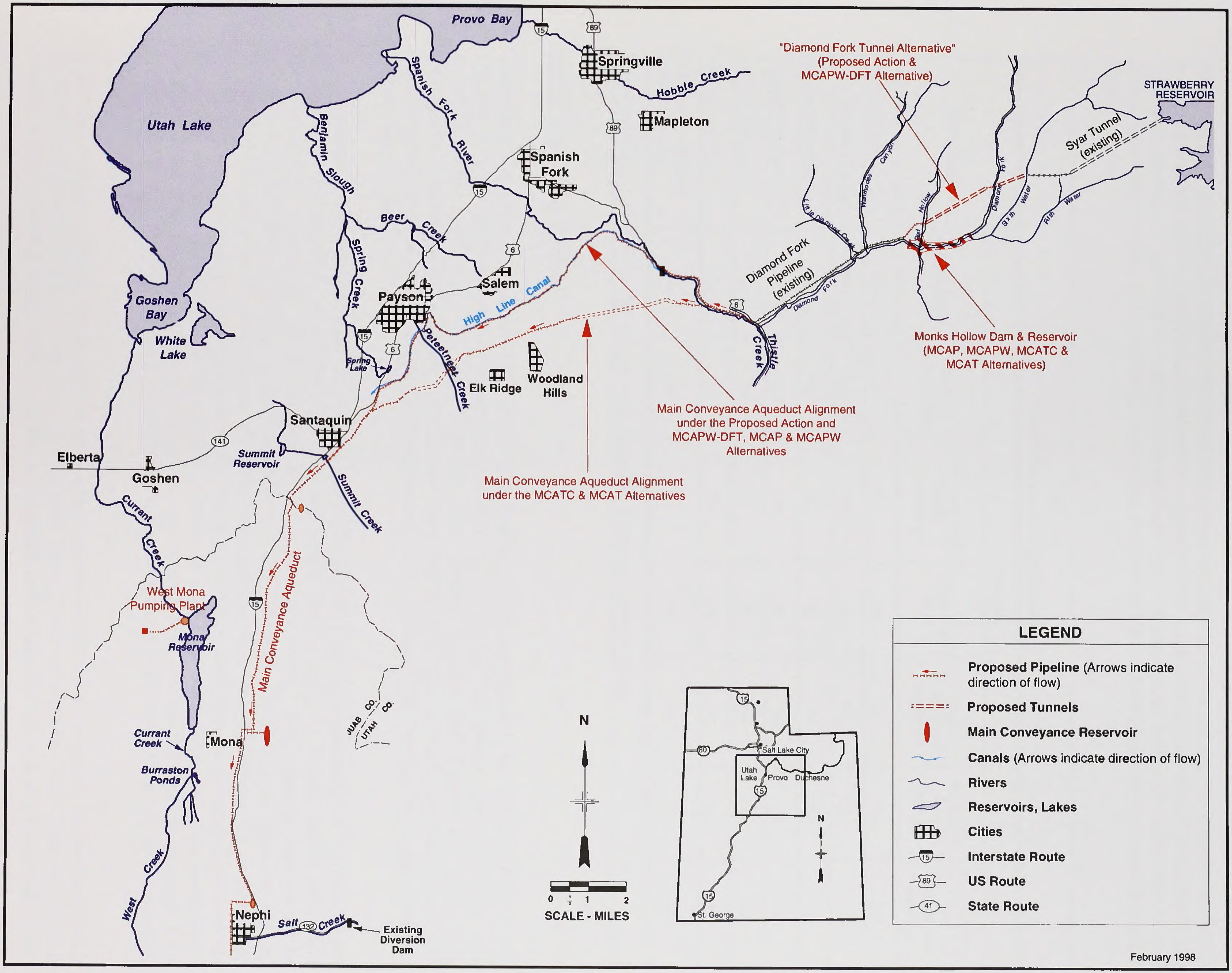
The SFN System has been planned to 1) meet the water requirements of irrigators, communities, and individuals in southern Utah and eastern Juab Counties; 2) cooperate with local water suppliers and natural resource management agencies in the joint use of facilities to deliver all available supplies; 3) minimize project costs to the federal government, the CUWCD, and the local water users; 4) improve water use efficiency; and 5) mitigate unavoidable adverse environmental impacts of the SFN System, Bonneville Unit, and earlier federal U.S. Bureau of Reclamation projects to the extent possible through the layout and operation of the project facilities to restore and conserve fish and wildlife resources and provide associated recreational opportunities.

S.2 Description of the Proposed Action and Alternatives

Several alternative routings and assemblages of facilities were considered that would meet the SFN System purpose and need. They include a Proposed Action and five action alternatives. One alternative (the MCAPW-DFT Alternative) has essentially the same facilities as the Proposed Action, but would not convey Strawberry Valley Project (SVP) water in the Main Conveyance Aqueduct. The remaining four alternatives (the MCAP, MCAPW, MCATC, and MCAT Alternatives) would each use Monks Hollow Dam and Reservoir in Diamond Fork Canyon (proposed as part of the Diamond Fork System, but not needed in the SFN System Proposed Action) to regulate transbasin diversions from Strawberry Reservoir. Variations among these remaining four alternatives involve the operation of the Main Conveyance Aqueduct with and without conveyance of SVP water and variations in aqueduct alignment between Spanish Fork Canyon and southeastern Utah Valley (with and without a tunnel system through Loafer, Tithing, and Dry Mountains east of Salem). The proposed locations of the Proposed Action and alternatives are shown on Map S-1.

Finally, a "no action" alternative was formulated that would require the Diamond Fork System to be completed with Three Forks Dam and Reservoir. Under the No Action Alternative, most of the Bonneville Unit water from Strawberry Reservoir would be delivered to Utah Lake, M&I water would be delivered to southern Utah County, and the delivery of irrigation water would be limited to an amount that could be diverted from the Spanish Fork River by existing diversion facilities. The Proposed Action and the alternatives are as follows:

Proposed Action (MCAP-DFT)	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative"
MCAPW-DFT Alternative	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative" and Without SVP Water Conveyance Alternative
MCAP Alternative	Main Conveyance Aqueduct with Monks Hollow Dam Alternative
MCAPW Alternative	Main Conveyance Aqueduct with Monks Hollow Dam and Without SVP Water Conveyance Alternative
MCATC Alternative	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam Alternative
MCAT Alternative	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam and Without SVP Water Conveyance Alternative
No Action Alternative	No SFN System, but Diamond Fork System would be completed with Three Forks Dam and Reservoir



Map S-1
Diamond Fork and SFN System Locations

The Proposed Action and alternatives described below were evaluated in detail and are discussed in this DEIS. Non-structural alternatives were previously discussed and evaluated in the *Bonneville Unit Final EIS* (USBR 1973). Additional alternatives were considered but eliminated from further evaluation, including alternative uses of SFN System water supply. The main differences among the Proposed Action and the alternatives are summarized in Table S-1.

Table S-1
General Comparison of Alternatives

Alternatives	Facilities						
	Syar Tunnel	Monks Hollow Dam	"Diamond Fork Tunnel Alternative"	Three Forks Dam	Main Conveyance Aqueduct	High Line Canal Replaced	SVP Water in Main Conveyance Aqueduct
Proposed Action	Yes	No	Yes	No	Yes	Yes	Yes
MCAPW-DFT Alternative	Yes	No	Yes	No	Yes	No	No
MCAP Alternative	Yes	Yes	No	No	Yes	Yes	Yes
MCAPW Alternative	Yes	Yes	No	No	Yes	No	No
MCATC Alternative	Yes	Yes	No	No	Yes	Yes*	Yes
MCAT Alternative	Yes	Yes	No	No	Yes	No	No
No Action Alternative (No SFN System)	Yes	No	No	Yes	No	No	NA

*Under the MCATC Alternative, the High Line Canal would be partially replaced by distribution pipelines.

S.2.1 Proposed Action

The Proposed Action would involve the construction, operation, and maintenance of 1) the "Diamond Fork Tunnel Alternative," a 6.1-mile-long series of tunnels and pipelines in the Diamond Fork drainage, to convey water from the existing Syar Tunnel and Sixth Water Aqueduct to the existing Diamond Fork Pipeline and 2) the Main Conveyance Aqueduct, a 43.6-mile-long pipeline and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties.

The Proposed Action would provide 127,400 acre-feet of Bonneville Unit water, consisting of 73,100 acre-feet of Bonneville Unit irrigation water for southern Utah and eastern Juab Counties, 11,200 acre-feet of M&I water for southern Utah County, and 43,100 acre-feet of Utah Lake water supply. The irrigation water would be delivered from SFN System facilities or made available in Mona Reservoir. The M&I water would be released to Utah Lake in exchange for a like amount of groundwater pumped from wells and springs by southern Utah County cities to meet their growing M&I needs. This exchange would be made because the pumped groundwater would otherwise flow into Utah Lake. The 43,100 acre-feet of Utah Lake water supply would be an exchange for Provo River water retained in Jordanelle Reservoir, used to meet M&I needs in Salt Lake and northern Utah Counties. This exchange is necessary because Jordanelle Reservoir stores Provo River flows that would normally flow into Utah Lake.

Associated with the Proposed Action (and the other action alternatives) would be changes to the operation of the Diamond Fork System to provide minimum flows in Sixth Water Creek and Diamond Fork Creek and periodic flushing flows in Diamond Fork Creek. Under the Proposed Action and the action alternatives, water rights

yielding an average 53,300 acre-feet annually in Utah Lake would be acquired from the CUWCD by the United States. This average yield is needed to ensure the Bonneville Unit's ability to make water exchanges to Jordanelle Reservoir and to emulate historical water levels in Utah Lake, thus avoiding impacts to the lake that would be caused by increased drawdown. Local distribution systems would convey Bonneville Unit water from SFN System facilities to farmlands and eligible cities. The restoration of existing distribution systems and the construction of new distribution systems would be related actions to the Proposed Action, as described below in Section S.2.8.

After the necessary approvals and federal funding are obtained, construction of the Proposed Action would occur over a period of approximately 9 years. Construction would begin in October 1999 and be completed by August 2008. Construction costs for the Proposed Action are estimated to be approximately $312 million.

S.2.2 MCAPW-DFT Alternative

The MCAPW-DFT Alternative would include the construction, operation, and maintenance of 1) the "Diamond Fork Tunnel Alternative," a 6.1-mile-long series of tunnels and pipelines in the Diamond Fork drainage to convey water from the existing Syar Tunnel and Sixth Water Aqueduct to the Diamond Fork Pipeline and 2) the 43.5-mile Main Conveyance Aqueduct and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) to deliver Bonneville Unit irrigation water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. M&I water to southern Utah County would be accomplished by exchange as described in the Proposed Action. The physical facilities of the MCAPW-DFT Alternative would be nearly the same as those of the Proposed Action. In the MCAPW-DFT Alternative, however, the Main Conveyance Aqueduct would not deliver SVP water and would not replace the High Line Canal, but would parallel the High Line Canal in the Salem and Payson areas. The construction period of the MCAPW-DFT Alternative would be 9 years. The construction cost would be approximately $281 million, or 90 percent of the Proposed Action.

S.2.3 MCAP Alternative

The MCAP Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 43.6-mile-long pipeline, and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline (located on the north side of Highway 6 at Diamond Fork Road) to southern Utah and eastern Juab Counties. The Main Conveyance Aqueduct would deliver irrigation water to the same agricultural lands in southern Utah and eastern Juab Counties as the Proposed Action.

The MCAP Alternative differs from the Proposed Action in that it would not include construction of the "Diamond Fork Tunnel Alternative." Instead, it would be accompanied with the construction of Monks Hollow Dam and Reservoir in the Diamond Fork drainage. These physical differences would change the operation of the Diamond Fork System and produce less flow in the Diamond Fork Pipeline and more flow in Diamond Fork Creek compared to the Proposed Action. The M&I water provided for southern Utah County would be delivered directly from the Main Conveyance Aqueduct. The construction period for the MCAP Alternative would be approximately 9 years. The estimated cost of this alternative, including the cost of Monks Hollow Dam, would be approximately $298 million, or 96 percent of the cost of the Proposed Action.

S.2.4 MCAPW Alternative

The MCAPW Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 43.5-mile pipeline and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver Bonneville Unit irrigation water from the terminus of the Diamond Fork Pipeline to the Santaquin area of southern Utah County and to eastern Juab County and to deliver Bonneville Unit M&I water to southern Utah County communities. The MCAPW Alternative would include construction of Monks Hollow

Dam and Reservoir in the Diamond Fork drainage. The Main Conveyance Aqueduct portion would be similar to that of the Proposed Action, in that agricultural acreage to be provided with Bonneville Unit irrigation water with the MCAPW Alternative would be the same as the Proposed Action. M&I water to southern Utah County would be delivered directly from the Main Conveyance Aqueduct.

The MCAPW Alternative differs from the MCAP Alternative in that the Main Conveyance Aqueduct would not carry SVP water. The Spanish Fork River would convey all SVP water. The MCAPW Alternative would include construction of a turnout at the end of the Diamond Fork Pipeline to release water to Diamond Fork Creek near its confluence with the Spanish Fork River.

The Main Conveyance Aqueduct under the MCAPW Alternative would follow a similar alignment to that of the Proposed Action; however, the pipeline would not replace the High Line Canal between Spanish Fork and Santaquin and would be routed parallel to the High Line Canal on a separate alignment.

The construction period for the MCAPW Alternative would be 9 years. The construction cost, including the cost of Monks Hollow Dam, would be approximately $267 million, or 86 percent of the cost of the Proposed Action.

S.2.5 MCATC Alternative

The MCATC Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 40.1-mile pipeline and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. The MCATC Alternative Main Conveyance Aqueduct would follow a different alignment in southern Utah County than that of the Proposed Action. This alignment would require tunneling through Loafer Mountain, Tithing Mountain, and Dry Mountain. Under the MCATC Alternative, the water supply would be identical to that provided by the Proposed Action. The locations of certain turnouts under the MCATC Alternative would differ from those for the Proposed Action. The construction period for the MCATC Alternative is projected to be 9 years, with a construction cost, including the cost of Monks Hollow Dam, of approximately $324 million, or 104 percent of the Proposed Action.

S.2.6 MCAT Alternative

The MCAT Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 40.1-mile pipeline and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver Bonneville Unit water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. The MCAT Alternative Main Conveyance Aqueduct would follow the same alignment as the MCATC Alternative; however, the MCAT Alternative would not carry SVP water. SVP water would continue to be conveyed in the Spanish Fork River. Turnouts would be similar to the MCATC Alternative; however, Turnout SU1 would not be constructed. The construction period for the MCAT Alternative would be approximately 9 years. The construction cost, including the cost of Monks Hollow Dam, would be approximately $285 million, or 91 percent of the Proposed Action.

S.2.7 No Action Alternative

Under the No Action Alternative, the SFN System would not be constructed. However, 96,800 acre-feet of Bonneville Unit water stored in Strawberry Reservoir would be delivered through the Diamond Fork System. The operation of the Diamond Fork System would be changed to provide the legislatively-mandated minimum streamflows in Sixth Water Creek and Diamond Fork Creek and periodic flushing flows in Diamond Fork Creek. Of the 96,800 acre-feet, 14,700 acre-feet would be available for M&I or irrigation use in southern Utah County, and the balance would be delivered to Utah Lake to facilitate an exchange to Jordanelle Reservoir for M&I use

in Salt Lake County. The Diamond Fork facilities constructed under the No Action Alternative would include the existing Syar Tunnel, Sixth Water Aqueduct, and Diamond Fork Pipeline, and the proposed Three Forks Dam. Under the No Action Alternative, no water rights in Utah Lake would be acquired from the CUWCD by the United States.

The No Action Alternative would not require the construction of Monks Hollow Dam and Reservoir; instead, Three Forks Dam would be constructed as part of the Diamond Fork System. The facilities would be similar to those described as Alternative C in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). The operation of the Diamond Fork System would be modified to comply with the fishery flow requirements of CUPCA. The construction period for the No Action Alternative would be approximately 3.5 years. The construction cost would be approximately $30 million, or 10 percent of the cost of the Proposed Action.

S.2.8 Related Actions (Local Development)

Various local projects would be implemented concurrently with the SFN System, including facilities to distribute Bonneville Unit water from the SFN System to farm lands and cities and to improve agricultural water distribution and use. These local projects would also facilitate the conveyance of non-Bonneville Unit water. Some local facilities already exist, but would be rehabilitated; others would need to be constructed. Rehabilitation and construction of local facilities would not be part of the federally-funded SFN System; they would be related actions that would be constructed by local water companies or by individual irrigators. However, they are necessary to meet the purposes and needs of the SFN System and would be a consequence of SFN System development.

This DEIS addresses the construction and operation of local development and identifies the associated environmental impacts. This DEIS analyzes the environmental impacts of the anticipated local irrigation and M&I distribution systems because they are interrelated projects that could contribute additional impacts. Local cities, irrigation companies, and irrigators developing future irrigation and distribution systems with federal assistance may need to perform some additional analyses in order to comply with the provisions of NEPA that are applicable at that time.

S.3 Areas of Controversy

Most areas of controversy have been resolved through an active and ongoing coordination effort by the CUWCD, DOI, the Mitigation Commission, State and federal agencies, and local water users. However, some areas of controversy remain.

S.3.1 Monks Hollow Dam

Cooperating agencies, organizations, and individuals have expressed concern over the construction of Monks Hollow Dam, which would complete the Diamond Fork System as planned in the *1988 Bonneville Unit Definite Plan Report* (USBR 1988a). As a result of this concern, the "Diamond Fork Tunnel Alternative" has been considered in two of the alternatives (including the Proposed Action) that would meet the purpose and need of the SFN System without constructing Monks Hollow Dam.

S.3.2 Water Use Conversion and Growth Inducement

Cooperating agencies have expressed concern that by bringing more water into southern Utah and eastern Juab Counties, urban growth in these areas would increase even though the majority of water delivered into the SFN System would be irrigation water. Cooperating agencies are concerned that water from local canyons, which is presently being used for irrigation, could be converted into M&I water for subdivisions in the foothills.

Cooperating agencies are also concerned that housing or other developments east of Interstate 15 (I-15), which may directly or indirectly come about because of availability of irrigation water no longer being used for irrigation, could impact the critical and high-value big game winter range. Concerns regarding the general potential for increased population growth attributable to additional supplies of water in southern Utah and eastern Juab Counties have also been expressed by environmental groups.

A 1994 study by the Utah State Office of Planning and Budget (OPB 1994) estimated an average growth in total employment in Utah and Juab Counties of about 2.3 percent per year. This estimate was developed without consideration of the construction of the SFN System or the introduction of supplemental irrigation water.

With respect to direct population increases induced by construction and operation of the SFN System, it is assumed that the CUWCD would use its own employees to perform operation and maintenance duties; thus, no change or shift in regional baseline population is expected as a result of the construction of the SFN System. Based on discussions with irrigators in the local area, no additional, significant farm-related employment would occur as a result of the increase in agricultural production from water deliveries.

Two of the needs for the SFN System are to supply a limited amount of M&I water to meet growth demands already projected and to supply supplemental irrigation water. Agricultural water that would be delivered by the SFN System would be contracted for that sole purpose; any proposed changes in water use would require approval from the CUWCD and the DOI and would necessitate additional environmental review. Although it has not been demonstrated that growth inducements would definitely occur, this remains a potential area of controversy since it is also very difficult to demonstrate that it definitely would not occur. It is the conclusion in this DEIS that construction and operation of the SFN System would not induce growth in the local or regional area. Further, because of restrictions in converting Bonneville Unit irrigation water to non-irrigation purposes, the diversion of irrigation water to foothill subdivisions could not occur without specific DOI approval and additional NEPA compliance efforts. Moreover, it is the continuing policy of the CUWCD that no contracts for delivery of SFN System water will be executed with any water user who proposes, or subsequently acts, to convert non-Bonneville Unit water to non-irrigation purposes.

S.3.3 Water Allocations

As part of the overall concern about the operation of the Bonneville Unit, the issue has been raised that the allocation of water from Strawberry Reservoir needs to be rethought and adjusted. Rather than providing water for irrigation in southern Utah and eastern Juab Counties, as was contemplated in the *Bonneville Unit Final EIS* (USBR 1973) and in CUPCA, it has been proposed that there should be an increase in M&I water amounts provided to Salt Lake County. This issue was raised by individuals and officials from Salt Lake County. At the present time, contracts have been negotiated with the various cities and water user groups in Utah and Juab Counties to reimburse the federal government for this water supply. Therefore, since none of the entities in Salt Lake County capable of contracting with the federal government to repay the cost of this M&I water have indicated a willingness to do so, it is extremely difficult to ignore the legislation, the previous allocation of water, and the willing contractors in Utah and Juab Counties. Nevertheless, this issue has been addressed in more detail in Sections 1.6.1.1 and 1.6.1.2 of this DEIS.

S.3.4 Water Conservation

Cooperating agency comments raised concerns that the approach used by the CUWCD is a passive water conservation program and not an active water conservation program. An active water conservation program would reduce the amount of water that would be needed and, therefore, potentially reduce some of the environmental impacts of project construction, operation, and maintenance. The water conservation program authorized in Section 207 of CUPCA required, among other things, 1) the preparation of a water management improvement plan; 2) establishment of a water conservation goal of conserving over 48,000 acre-feet of water by the year 2012;

3) establishment of a water management improvement inventory; 4) a comparative analysis of each cost-effective and environmentally acceptable measure; 5) an implementation schedule; 6) an assessment of the implemented conservation measures; and 7) substantial penalties for the CUWCD if it is found to be in non-compliance. The CUWCD has administered a very active water conservation program that is being implemented on schedule in accordance with CUPCA and which can potentially reduce the environmental impacts associated with the CUP and other privately developed projects.

S.4 Major Beneficial and Adverse Impact Conclusions

S.4.1 Proposed Action and MCAPW-DFT Alternative

The major beneficial impacts of the Proposed Action and the MCAPW-DFT Alternative would be increased crop production in southern Utah and eastern Juab Counties through both an increased irrigation water supply from Strawberry Reservoir and increased irrigation efficiency, and the provisions of M&I water to support projected M&I growth in southern Utah County. In addition, routing water through the "Diamond Fork Tunnel Alternative" would lead to improved aquatic and riparian habitat, a significant increase in trout production in Diamond Fork Canyon, and an improvement in angling opportunities.

The major adverse impacts of the Proposed Action and the MCAPW-DFT Alternative would occur to a threatened plant species. The threatened Ute ladies'-tresses (*Spiranthes diluvialis*), an orchid inhabiting the riparian zone along Diamond Fork Creek and the Spanish Fork River, could suffer potential degradation or loss of habitat resulting from a vastly different flow regime from the historical baseline. However, monitoring and future adaptive management changes to this flow regime would mitigate for any significant loss.

The above impacts would occur as a result of operation; however, some short- and long-term construction-related impacts would also occur. The most significant construction-related impacts include increased traffic delays within Spanish Fork Canyon and Diamond Fork Canyon, increased noise and vehicle emissions, and the temporary loss of big game winter range habitat east of I-15 during the construction of the Main Conveyance Aqueduct. There would be a potential temporary disruption of fall migration for deer and elk in the Red Hollow area during construction of the Red Hollow Pipeline and Red Mountain Tunnel. One golden eagle (*Aquila chrysaetos*) nest could be disturbed for up to two nesting seasons, and there could be an unquantified impact to black bear (*Ursus americanus*) since one known denning area is in proximity to proposed facilities in the Red Hollow drainage.

S.4.2 MCAP, MCAPW, MCATC, and MCAT Alternatives

Beneficial and adverse operational impacts of the MCAP, MCAPW, MCATC, and MCAT Alternatives would be similar to those described for the Proposed Action and MCAPW-DFT Alternative. However, the construction and operation of Monks Hollow Dam in lieu of the "Diamond Fork Tunnel Alternative" would cause additional significant permanent habitat loss, reduced miles of stream trout fishery resulting from high flows in Sixth Water Creek, and the inundation of about 2.5 miles of Diamond Fork Creek. Two known golden eagle nests would be affected. One of the nests would be disturbed for 3 years during construction of the dam and one would be permanently inundated. Traffic in Diamond Fork Canyon would be permanently impacted since a road would not be built around the dam and reservoir. While other roads to the higher country exist, they are longer than Diamond Fork Road.

S.4.3 No Action Alternative

The No Action Alternative would result in fewer beneficial impacts and greater adverse impacts within the Diamond Fork drainage than the action alternatives. Without the control of flows in Sixth Water Creek, there

would be significant erosion of the stream channel. In addition, increased sediment loading in the Spanish Fork River would be destructive to fisheries. This alternative would allow for a significant transbasin diversion of water for municipal use along the Wasatch Front.

The construction of Three Forks Dam would have similar impacts to the construction of Monks Hollow Dam. Permanent habitat loss would be less, however, and access to the upper canyon would not be permanently lost.

S.5 Issues to be Resolved

S.5.1 Contracts and Agreements

A number of contracts and agreements with water users and landowners would need to be negotiated to address such questions as sharing of facilities, exchange of water, and operation of irrigation wells. These are discussed in Section 1.7 of this DEIS.

S.5.2 Recreation Trail Funding

The CUWCD would serve as the sponsoring agency for a recreation trail proposed under the Proposed Action and MCAP Alternative. However, a financial plan for the development of the proposed recreation trail along the High Line Canal has not yet been formulated. It is anticipated that the combined efforts of interested citizens groups and various local, State, and federal agencies would result in the completion of the trail. The CUWCD will provide all the necessary funding for construction, operation, and maintenance of the recreation trail if no other funding sources is available.

[illegible]

[illegible]

5.5.1 Contracts and Agreements

[illegible]

5.5.2 [illegible]

[illegible]

Chapter 1

DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Chapter 1
Description of the Proposed Action and Alternatives

1.1 Introduction

This Draft Environmental Impact Statement (DEIS) addresses potential impacts related to construction and operation of the proposed Spanish Fork Canyon-Nephi Irrigation System (SFN System) and the "Diamond Fork Tunnel Alternative" in the Diamond Fork System. This DEIS is intended to satisfy the disclosure requirements of the National Environmental Policy Act (NEPA) and will be used by officials of the Central Utah Water Conservancy District (CUWCD), the U.S. Department of Interior (DOI), and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) in conjunction with other relevant materials to plan actions and make decisions. In addition, this DEIS would serve as the NEPA compliance document for the various contracts and agreements that would be negotiated to cover the construction and operation of the SFN System. This DEIS also fulfills commitments made in previous EISs such as the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990).

The SFN System is one of the proposed systems of the Bonneville Unit of the Central Utah Project (CUP), which would develop Utah's water resources for irrigation, municipal and industrial (M&I), fish and wildlife, and recreation. The SFN System would deliver water through the proposed Main Conveyance Aqueduct to southern Utah County and eastern Juab County as far south as the Nephi area. The SFN System would receive its water through a transbasin diversion from the Uinta Basin by means of the Diamond Fork System. This chapter presents a complete description of the Proposed Action and its alternatives.

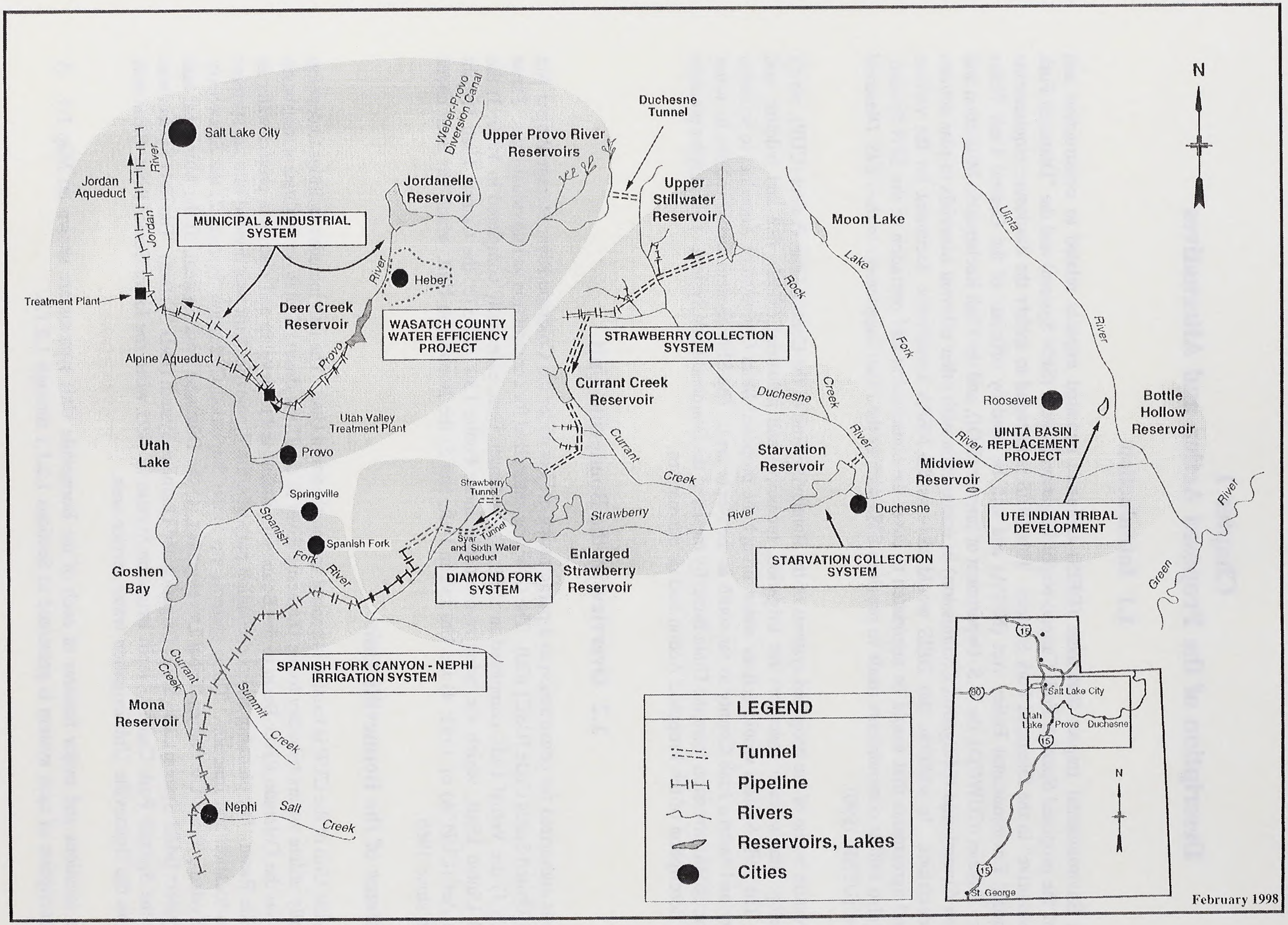
1.2 Overview of the Bonneville Unit

The CUP was authorized for construction as a participating project under the Colorado River Storage Project Act of 1956 (43 United States Code [USC] 620). The CUP was authorized for construction as individual units. These units include 1) the Vernal Unit, completed in 1962; 2) the Jensen Unit, essentially completed in 1980; 3) the Upalco and Uintah Units, which are being re-evaluated under Public Law 102-575, the Central Utah Project Completion Act (CUPCA) of 1992; 4) the Ute Indian Unit; and 5) the Bonneville Unit, which has been under construction since 1965.

1.2.1 Systems of the Bonneville Unit

The Bonneville Unit of the CUP is located in central and northeastern Utah. The unit includes facilities to develop and more fully utilize waters tributary to the Duchesne River in the Uinta Basin of Utah, to facilitate a transbasin diversion from the Colorado River Basin to the Bonneville Basin, and to develop and distribute project water in the Bonneville Basin. For planning and coordination purposes, the Bonneville Unit was divided into six systems according to location and function. These systems are 1) the Starvation Collection System, 2) the Strawberry Collection System, 3) the Ute Indian Tribal Development, 4) the Diamond Fork System, 5) the Municipal and Industrial System (M&I System), and 6) the Irrigation and Drainage System (I&D System). The I&D System was replaced by the Spanish Fork Canyon-Nephi Irrigation System in 1995 when the lower Sevier River Basin was removed from the Bonneville Unit irrigation water service area.

The relative locations and major features of each of the Bonneville Unit systems are shown on Map 1-1. A summary description of each system is presented in Sections 1.2.1.1 through 1.2.1.6.



Map 1-1
Location of Bonneville Unit Systems

1.2.1.1 *Starvation Collection System*

The Starvation Collection System was completed in 1970. The system develops water for irrigation and M&I uses and provides flood control, recreation, and fish and wildlife benefits in the Duchesne area of the Uinta Basin. Water storage is provided by the 167,310 acre-foot Starvation Reservoir, located on the Strawberry River just above its confluence with the Duchesne River. Starvation Reservoir is filled by winter and spring flows of the Duchesne and Strawberry Rivers. Duchesne River water is diverted by Knight Diversion Dam and conveyed to the reservoir through the Starvation Feeder Conduit.

Starvation Reservoir provides a significant benefit to irrigators along the Duchesne River in the form of water delivery in the late summer and fall when streamflows typically decline below the levels needed for irrigation diversion. Water accumulated in Starvation Reservoir provides 21,400 acre-feet of irrigation water and 500 acre-feet of M&I water for use in the Uinta Basin. The availability of this water from storage in Starvation Reservoir increases the amount of water that can be diverted from the Duchesne River to Strawberry Reservoir. The reservoir also provides fishery benefits and public recreation.

1.2.1.2 *Strawberry Collection System*

The Strawberry Collection System, completed in the late 1980s, diverts part of the flows of Rock Creek and eight other tributaries of the Duchesne River and conveys the diverted flows through the 36.8-mile-long Strawberry Aqueduct to Strawberry Reservoir. Upper Stillwater Reservoir, with a capacity of 33,100 acre-feet, serves as a regulating reservoir at the head of the Strawberry Aqueduct to provide temporary storage during the high runoff period for later diversion to the aqueduct and storage in Strawberry Reservoir. Currant Creek Reservoir, with a total capacity of 15,670 acre-feet, diverts Currant Creek and five tributaries into the Strawberry Aqueduct.

The capacity of Strawberry Reservoir was enlarged from 273,000 acre-feet to 1,106,500 acre-feet by the construction of Soldier Creek Dam on the Strawberry River. Some of the water stored in the reservoir is released to provide fishery flows, but most of the stored water is for transbasin diversion to the Bonneville Basin. In addition to water supply, the Strawberry Collection System provides flood control, recreation, and fish and wildlife benefits.

1.2.1.3 *Ute Indian Tribal Development Project*

The purpose of the Ute Indian Tribal Development Project is to mitigate stream-related fish and wildlife losses on Indian lands associated with the Bonneville Unit. Bottle Hollow Reservoir has been constructed to compensate the Ute Indian Tribe for economic losses associated with stream fishing on the portion of Rock Creek located on the Uintah and Ouray Indian Reservation. With a surface area of 420 acres, this reservoir provides fishing opportunities, wildlife habitat, and a basis for recreation-oriented enterprises to provide additional employment and income for tribal members. Section 505(f) of CUPCA allowed for $10 million to be appropriated for the development of fishing and hunting facilities in lieu of the construction of Lower Stillwater Dam, a feature specified in the 1965 Deferral Agreement.

1.2.1.4 *Diamond Fork System*

The Diamond Fork System will allow for the transbasin diversion of Bonneville Unit water from Strawberry Reservoir in the Colorado River drainage basin to Spanish Fork Canyon in the Bonneville Basin. As originally proposed, the project features included Syar Tunnel and Sixth Water Aqueduct, which form a continuous 7.3-mile conduit; Monks Hollow Dam and Reservoir to regulate deliveries; and the completed 7-mile Diamond Fork Pipeline to convey water to the confluence of Diamond Fork Creek and the Spanish Fork River, where it would connect with the SFN System. Syar Tunnel and Sixth Water Aqueduct have been constructed and are operational;

Monks Hollow Dam has not been constructed. The Diamond Fork Pipeline has been constructed, but is not operational. Under the Proposed Action and one of the SFN System alternatives, Monks Hollow Dam and Reservoir would not be built. Instead, a series of tunnels and pipelines would be built to convey the transbasin diversion water from the end of Sixth Water Aqueduct to the upstream end of the existing Diamond Fork Pipeline. The tunnels and pipelines would comprise the "Diamond Fork Tunnel Alternative." Under the remaining SFN System action alternatives, the Diamond Fork System would be completed with Monks Hollow Dam and Reservoir. CUPCA authorized additional appropriations for the Diamond Fork System and stipulated certain minimum flows for Sixth Water and Diamond Fork Creeks. Certain aspects of the Diamond Fork System are evaluated along with the SFN System in this DEIS because of changes authorized by CUPCA and because the two systems are interdependent in their layout and operation. More detailed information about the Diamond Fork System is provided in Section 1.5.2.

1.2.1.5 Municipal and Industrial System (M&I System)

The Bonneville Unit M&I System provides M&I water to Salt Lake, Utah, and Wasatch Counties and supplemental irrigation water to Wasatch and Summit Counties. The system also provides flood control, recreation, and fish and wildlife measures. Jordanelle Dam is the major feature of the M&I System. The 300-foot-high dam and 362,500 acre-foot capacity reservoir, located on the Provo River about 6 miles north of Heber City, were completed in 1991. Water is developed by storing Provo River flows that historically had flowed into Utah Lake. Under the SFN System, Utah Lake water would be replaced by Bonneville Unit return flows to the lake, water rights previously acquired by the CUWCD in Utah Lake, direct releases of water from Strawberry Reservoir to Utah Lake, and flows that are surplus to Utah Lake rights. The M&I water for northern Utah County (20,000 acre-feet per year) and Salt Lake County (70,000 acre-feet per year) is released from Jordanelle Reservoir and then diverted from the Provo River at two locations: Deer Creek Dam and the Olmsted Diversion Dam. From these two diversions, the water is conveyed to the Salt Lake County area by the 38-mile-long Jordan Aqueduct and to northern Utah County through the 14-mile Alpine Aqueduct. Water for use in Wasatch County will be released from Jordanelle Reservoir for delivery through local irrigation and secondary M&I systems. Water for use in Summit County will be provided from Washington, Trial, and Lost Lakes on the headwaters of the Provo River, by exchange with storage in Jordanelle Reservoir.

1.2.1.6 Spanish Fork Canyon-Nephi Irrigation System (SFN System)

The SFN System, which is the subject of this DEIS, replaces the I&D System. The SFN System would be located in central Utah in the Diamond Fork drainage, Spanish Fork Canyon, and the east benches of southern Utah and eastern Juab County. The SFN System would deliver water for irrigation and municipal uses in southern Utah County and irrigation use in eastern Juab County. The water supply for the SFN System would be provided from Strawberry Reservoir via transbasin diversion by the Diamond Fork System.

CUPCA reauthorized construction of the I&D System to convey water to Sevier Bridge Reservoir on the Sevier River. However, CUPCA also authorized the construction of alternate features to deliver water within the Utah Lake drainage basin, in case the plan to deliver water to the Sevier River basin was not viable. When Millard and Sevier Counties withdrew from participation in the CUP, delivery of water to the Sevier River basin was no longer viable and the alternate plan was activated and named the "Spanish Fork Canyon-Nephi Irrigation System."

1.2.2 Other CUPCA Program Components

In addition to providing direction for the completion of the six systems of the Bonneville Unit (in some cases with additional features), CUPCA authorized the seven additional program components listed below. Descriptions of each component are provided in Sections 1.2.2.1 through 1.2.2.7. Figure 1-1 summarizes the following seven additional components, along with the six original systems of the Bonneville Unit:

Bonneville Unit Components

Original Systems

STARVATION COLLECTION SYSTEM
- Knight Diversion Dam
- Starvation Feeder Conduit
- Starvation Reservoir
- Duchesne River Canals

STRAWBERRY COLLECTION SYSTEM
- Soldier Creek Dam and enlarged Strawberry Reservoir
- Upper Stillwater Reservoir
- Currant Creek Reservoir
- Strawberry Aqueduct

M&I SYSTEM
- Jordanelle Reservoir
- Jordan Aqueduct
- Alpine Aqueduct
- Stabilization of High Mountain Lakes (Trial, Lost, & Washington)

UTE INDIAN TRIBAL DEVELOPMENT
- Bottle Hollow Reservoir
- Wildlife Habitat Development

DIAMOND FORK POWER SYSTEM
- Syar Tunnel
- Sixth Water Aqueduct
- Last Chance Powerplant
- Monks Hollow Reservoir
- Monks Hollow Powerplant
- Diamond Fork Pipeline
- Diamond Fork Powerplant

I&D SYSTEM
- Wasatch Aqueduct (tunnels and pipelines)
- Mona-Nephi Canal
- Mona, West Mona, and Nephi Pumping Plants
- Nephi-Sevier Canal
- Mosida area canals and powerplants

Systems Reauthorized by CUPCA

SECTION 202 DIAMOND FORK SYSTEM
- Diamond Fork Pipeline (Constructed)
- Tanner Ridge Tunnel
- Diamond Fork Siphon
- Red Mountain Tunnel
- Red Hollow Pipeline

SECTION 202 SFN SYSTEM [1]
- Main Conveyance Aqueduct (pipeline from Diamond Fork to Nephi)

New Components Authorized By CUPCA

SECTION 202 WASATCH COUNTY WATER EFFICIENCY PROJECT
- Lateral lining
- Pipeline to Daniel Irrigation Company

SECTION 202 CONJUNCTIVE USE OF SURFACE & GROUNDWATER
- Sec. 202(a)(2)- Study and Development by Utah Division of Water Resources, in Salt Lake, Utah, Davis, Wasatch, and Weber Counties

SECTION 202 ADDITIONAL STUDIES
- Sec. 202(a)(4)- Study of Utah Lake Salinity Control
- Sec. 202(a)(5)- Study of Provo River augmentation (i.e. Strawberry-Provo Conveyance Study)

SECTION 203 UINTA BASIN REPLACEMENT PROJECT
- Big Sand Wash Reservoir and pipelines
- Canal rehabilitation

SECTION 207 WATER MANAGEMENT IMPROVEMENT
- Sec. 207(b)- Water Management Improvement Plan
- Sec. 207(b)(5)- Water Conservation Credit Program
- Sec. 207(c)- Water Conservation Pricing Study
- Sec. 207(d)- Study of Coordinated Operations
- Sec. 207(f)- Utah Water Conservation Advisory Board

TITLE III FISH, WILDLIFE, AND RECREATION MITIGATION AND CONSERVATION
- Diamond Fork Creek
- Provo River and Utah Lake
- Duchesne and Strawberry
- Statewide Fish, Wildlife, and Recreation Enhancement
- Fish, Wildlife, and Conservation

TITLE V UTE INDIAN WATER RIGHTS
- Ute Indian Water Rights Settlement

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[1] Alternate system to the I&D System. Authorized in CUPCA, Section 202(a)(1)(B)(iii).

Figure 1-1
Bonneville Unit Components

- Wasatch County Water Efficiency Project and Daniel Replacement Project
- Conjunctive Use of Surface Water and Groundwater
- Additional Studies of Utah Lake Salinity and Provo River Water Supply
- Uinta Basin Replacement Project (UBRP)
- Water Management Improvement
- Fish, Wildlife, and Recreation Mitigation and Enhancement
- Ute Indian Water Rights Settlement

1.2.2.1 Wasatch County Water Efficiency Project and Daniel Replacement Project

The Wasatch County Water Efficiency Project and Daniel Replacement Project would improve water use efficiency in the Heber Valley by delivering pressurized irrigation water and making it possible for farmers to convert from flood to sprinkler irrigation. Water conserved by the project would be used to supplement flows of the Heber Valley streams. The project would also provide the Daniel Irrigation Company with replacement water after its diversions from the upper Strawberry River basin are terminated as provided in Section 303 of CUPCA. Water conserved by the project from the CUP agricultural supply would be used to provide the replacement water. This project is described in the *Final Environmental Impact Statement - Wasatch County Water Efficiency Project and Daniel Replacement Project* (CUWCD 1996a), and the *Wasatch County Water Efficiency Project Feasibility Study* (CUWCD 1997e). The Mitigation Commission signed its Record of Decision on March 12, 1997, and the Department of the Interior signed its Record of Decision on March 21, 1997, both selecting the Proposed Action for implementation. The pre-construction phase has been initiated.

The termination of the transbasin diversion and restoration of summer flow in the Strawberry River and its tributaries upstream of Strawberry Reservoir would, in effect, increase the water supply to Strawberry Reservoir by an average of 2,900 acre-feet per year. In accordance with Section 303 of CUPCA, the 2,900 acre-feet would be used to increase minimum streamflows in the upper Strawberry River tributaries and the lower Strawberry River and/or exchanged into the Strawberry Collection System to be released to other streams within the Uinta Basin.

1.2.2.2 Conjunctive Use of Surface Water and Groundwater

Conjunctive use of surface water and groundwater consists of the planning and development of systems to allow groundwater recharge, management, and conjunctive use of surface water and groundwater. Section 202(a)(2) of CUPCA authorizes the Utah Division of Water Resources to conduct this program in Salt Lake, Utah, Davis, Wasatch, and Weber Counties and authorized federal funding for that purpose. This program has the following objectives: to provide greater efficiency in the use of water from federally-funded facilities as well as local sources, to prevent the further migration of useable groundwater into aquifers of poor quality water, to reduce groundwater pumping costs, to conserve Utah's water resources, and to facilitate maintenance of year-round streamflows for fish, wildlife, and water quality valued in streams such as the Provo River. The program is intended to build upon studies and demonstration projects that have been undertaken by local entities in those counties.

1.2.2.3 Additional Studies of Utah Lake Salinity and Provo River Water Supply

Section 202 of CUPCA authorized several studies involving water management in the Bonneville Unit. One was a study of the feasibility of reducing the salinity of Utah Lake. Two others involved the water supplies of the Provo River, consisting of a study of operations including the development of a model to simulate operation of the river system, and a study of direct delivery of Colorado River Basin water from Strawberry Reservoir or elsewhere in the Strawberry Collection System to the Provo River Basin. These studies have all been initiated.

1.2.2.4 Uinta Basin Replacement Project

Section 203 of CUPCA authorized the UBRP to provide additional water through more efficient use of existing supplies. As authorized, UBRP included Pigeon Water Reservoir, McGuire Draw Reservoir, Clay Basin Reservoir, and the Farnsworth Canal rehabilitation. However, preliminary feasibility studies determined that alternative projects would be more beneficial and less costly than the specific features authorized in CUPCA. These other projects consist of the enlargement of Big Sand Wash Reservoir, construction of a pipeline to convey M&I water to Roosevelt City, and the enlargement and rehabilitation of seven laterals on the Farnsworth Canal System. They are presently described in the *Draft Upalco Unit Replacement Project Feasibility Study* (CUWCD 1996c).

The CUWCD is currently conducting NEPA compliance activities on the Upalco Unit Replacement Project. Water supply development under this project would include water supply development intended under UBRP by Section 203 of CUPCA. If the Upalco Unit is not constructed, the Section 203 project would require its own NEPA compliance process.

1.2.2.5 Water Management Improvement

Section 207 of CUPCA authorized a comprehensive program to improve water management within the CUP service area, including the establishment of water conservation goals to be achieved by year 2010. Specific purposes are to encourage water conservation and wise use, reduce the probability and duration of extraordinary water shortages, reduce water use and system costs, prevent unnecessary depletions that adversely affect environmental values or other public purposes, make effective use of available supplies before importation of water from the Bear River, and provide an objective basis for measuring achievements under this program. To achieve these purposes, the CUWCD has developed a Water Management Improvement Plan and is using its Water Conservation Credit Program to assist local agencies in funding measures. Also, as required by CUPCA, a Utah Water Conservation Advisory Board has been established to assist the CUWCD in establishing criteria and priorities for water conservation projects.

1.2.2.6 Fish, Wildlife, and Recreation Mitigation and Enhancement

Under Title III of CUPCA, the Mitigation Commission was established to develop plans and administer the mitigation and conservation program authorized by Congress. It is also a joint lead agency for the preparation of this DEIS with the CUWCD and DOI. CUPCA also established the Utah Reclamation Mitigation and Conservation Account, which would be funded by the federal government, the State of Utah, the CUWCD, and other project beneficiaries. The Mitigation Commission is charged with the administration of this account.

1.2.2.7 Ute Indian Water Rights Settlement

Title V of CUPCA contains a variety of provisions for the benefit of the Ute Indian Tribe that, together with earlier agreements, form the Ute Indian Water Rights Settlement. The associated provisions are intended to put the Tribe in the economic position envisioned at the initiation of the CUP, by quantifying the Tribe's reserved water rights, allowing increased beneficial use of such water, and providing funds for economic development through agriculture and other enterprises that would put the Tribe in the same economic position it would have enjoyed had the 1965 Deferral Agreement been fully implemented.

1.2.3 Bonneville Unit History

A Definite Plan Report (DPR) for the Bonneville Unit was prepared in 1964 (USBR 1964). That document paved the way for the start of construction of the Bonneville Unit in 1965. As development of the Bonneville Unit proceeded over time, changes occurred in the original plan. In 1988, the U.S. Bureau of Reclamation (USBR)

prepared the *1988 Bonneville Unit Definite Plan Report* (1988 DPR) (USBR 1988a) to update the Bonneville Unit plan. In October 1992, Congress enacted CUPCA, which modified the Bonneville Unit Definite Plan and indicated that the 1988 DPR (USBR 1988a) was approved by the Secretary of the Interior (for more detail on the development of the Bonneville Unit plan, see Section 1.5, Background and History).

1.2.4 Environmental Documentation History

In August 1973, the USBR issued the *Bonneville Unit Final EIS* (USBR 1973). That document was a programmatic Environmental Impact Statement (EIS) for the Bonneville Unit, but provided specific NEPA compliance for the construction of the Strawberry and Starvation Collection Systems. Several environmental organizations initiated a legal challenge to that document's adequacy (i.e., *Sierra Club v. Stamm*). In 1974, the United States District Court for the State of Utah ruled that the *Bonneville Unit Final EIS* (USBR 1973) was in compliance with NEPA (Ritter 1974). The decision was upheld by the United States Tenth Circuit Court of Appeals. The USBR committed to prepare a site-specific EIS for each of the remaining Bonneville Unit Systems (i.e., the M&I, Diamond Fork, and I&D Systems) before initiating construction.

A Draft EIS for the M&I System was issued in April 1979 (USBR 1979b), and a Final EIS was issued in October 1979 (USBR 1979a). A supplement to the M&I System's Final EIS was issued in March 1987 (USBR 1987a). A Draft EIS was prepared for the Diamond Fork Power System in June 1983 (USBR 1983) and a Final EIS in October 1984 (USBR 1984). Further refinements in the development plan prompted supplemental environmental analyses, which culminated in the issuance of the *Final Supplement to the FEIS, Diamond Fork System* in February 1990 (USBR 1990). The environmental analysis of the impacts on Utah Lake and Strawberry Reservoir from operation of the Bonneville Unit, including the Diamond Fork System and the I&D System, was deferred until the anticipated EIS on the I&D System. These issues are now included in this DEIS on the SFN System. The impact of the Bonneville Unit on Utah Lake is addressed in Section 2.3 of this document.

1.2.5 Integration of the Strawberry Valley Project with the Bonneville Unit

The Strawberry Valley Project (SVP) was constructed between 1906 and 1922 under the Reclamation Act of 1902. It provides irrigation water to approximately 43,000 acres in southern Utah County. As originally built, the SVP consisted of Strawberry Reservoir, Strawberry Tunnel (a transbasin diversion), a system of diversions and canals, and a hydroelectric plant. Since 1926, the SVP has been operated by the Strawberry Water Users Association (SWUA), whose Strawberry Reservoir water was delivered through Strawberry Tunnel, down Sixth Water Creek to Diamond Fork Creek, and into the Spanish Fork River. (The use of Strawberry Tunnel for irrigation water was discontinued in 1996 when the Syar Tunnel began to release water to Sixth Water Creek.) The water is then diverted from the Spanish Fork River into canals for distribution to SVP water users.

The SWUA has an allocation of 61,500 acre-feet of water from the enlarged Strawberry Reservoir. Under the Proposed Action, more than half of that amount would be delivered through the proposed Main Conveyance Aqueduct. The enlarged Strawberry Reservoir, which has a capacity of 1,106,500 acre-feet, provides long-term storage of both Bonneville Unit and SVP water from the Uinta Basin (the SVP has also developed Spanish Fork River water).

Paragraph 24 of the Strawberry Valley Project Repayment Contract (USBR 1940) gives the SWUA the authority to move SVP water from marginal land within the exterior boundaries of the SVP to other qualified lands within the exterior boundaries. As SWUA makes SVP land transfers in the future and if SWUA makes these transfers to lands within the boundaries of the CUP, future classification of the lands would be made to USBR standards.

The Diamond Fork System conveys SVP water from Strawberry Reservoir through the Syar Tunnel and the Sixth Water Aqueduct. Under the Proposed Action, the water from Sixth Water Aqueduct would flow through the proposed "Diamond Fork Tunnel Alternative" to the upper end of the existing Diamond Fork Pipeline. There,

some of the SVP water would be released to Diamond Fork Creek, and the rest would continue in the pipeline to the proposed SFN System Main Conveyance Aqueduct, from which the water would be delivered in the Spanish Fork area together with Bonneville Unit water. Under one of the alternatives, the rest of the SVP water would be released to the Spanish Fork River. The remaining four action alternatives would use a different approach to deliver the SVP water. Water from the Sixth Water Aqueduct would flow into Sixth Water Creek and then into the proposed Monks Hollow Reservoir on Diamond Fork Creek. Monks Hollow Reservoir would provide regulatory storage for Bonneville Unit water but not for SVP water, which would flow through the reservoir. Also, an average of 20,900 acre-feet of natural flow of Diamond Fork Creek would be bypassed through the reservoir and would not be stored. Water released from Monks Hollow Reservoir would be divided between Diamond Fork Creek and the Diamond Fork Pipeline, as described in Section 1.6.2.1. The Diamond Fork Pipeline would deliver SVP water to the SFN System Main Conveyance Aqueduct or to the Spanish Fork River, depending on whether the alternative includes SVP water delivery in the Main Conveyance Aqueduct.

The operation of the Bonneville Unit together with SVP water from Strawberry Reservoir is illustrated on Figure 1-2. The average annual flows shown in Figure 1-2 are only those flows that are a part of the Bonneville Unit and the SVP transbasin diversion; they do not include the natural flows of Diamond Fork Creek or the Spanish Fork River.

The conveyance and delivery of SVP water through the Diamond Fork and SFN Systems would be covered by an operating agreement among the DOI, CUWCD, SWUA, and possibly others, which would replace the current *Contract Among the United States, Central Utah Water Conservancy District, and Strawberry Water Users' Association Relating to the Operation and Maintenance of the Enlarged Strawberry Reservoir and the Related Facilities Jointly Used* (USBR 1991). This new contract is listed in Section 1.7.

The Bonneville Unit water delivered to Utah Lake from Strawberry Reservoir would provide 1) a portion of the exchange water needed for the Bonneville Unit M&I System previously described in Section 1.2.1.5 and 2) 11,200 acre-feet of Bonneville Unit M&I water for southern Utah County to be used through a groundwater exchange as described in Section 1.6.2. The average annual flows shown in Figure 1-2 and other flows listed in this chapter are based upon computer modeling of the Bonneville Unit hydrologic system using streamflows recorded during the 1930 through 1973 period. Future operational flows would vary from year to year based on hydrological conditions.

1.2.6 Utah Lake Water Rights Acquisition

The CUWCD has acquired 82,000 acre-feet of water rights in Utah Lake, which include 25,000 acre-feet of rights from Salt Lake City and approximately 57,000 acre-feet of secondary rights from Kennecott Copper Corporation. Under Bonneville Unit operation, these water rights are expected to yield an annual average of 53,300 acre-feet of water supply for the Bonneville Unit. This is only an average annual yield. In many years, the full 82,000 acre-feet of rights would be required for project use. In other years, these water rights would provide a lesser yield. The average yield is nearly the same as the average historic yield. In order to avoid increased drawdown of Utah Lake and the associated negative environmental impacts, no attempt was made to maximize the yield of these water rights beyond historic use. These water rights would be purchased from the CUWCD by the DOI and become part of the Bonneville Unit under the Proposed Action and the action alternatives.

As stated above, Utah Lake is the common operational interface of water transfers within the Bonneville Unit. Section 1.2.4 discusses and documents the environmental compliance of the various systems of the Bonneville Unit as well as some of the major changes that have occurred within the Bonneville Unit. (Cumulative impacts from the Bonneville Unit on Utah Lake are discussed in Section 2.3 of Chapter 2.)

Three key water supply parameters of the Bonneville Unit described in the various environmental and planning documents are summarized in Table 1-1. These parameters are 1) the transbasin diversion from Strawberry Reservoir to the Bonneville Basin, 2) the amount of transbasin diversion delivered directly to Utah Lake, and 3) the depletion of Provo River flows into Utah Lake.

Table 1-1
Comparison of Bonneville Unit Average Annual Water Supply Parameters (acre-feet)

Environmental Documentation	Transbasin Diversion[a]	Delivery to Utah Lake	Return Flow To Utah Lake	Provo River Depletion
Bonneville Unit Definite Plan Report (USBR 1964)	197,600	30,000	30,100	83,800
Bonneville Unit Final EIS (USBR 1973)	197,600	8,000	30,100	106,300
1988 Bonneville Unit Definite Plan Report (USBR 1988a)	199,200	48,600	23,300	98,500
Final Supplement to the FEIS, Diamond Fork System (USBR 1990)	163,400	32,300	23,300	98,500
SFN System DEIS	163,400	33,500[b]	33,800	98,500

[a]Includes 61,500 acre-feet of SVP water.
[b]Consists of 22,300 acre-feet of water for exchange with Jordanelle Reservoir and 11,200 acre-feet of M&I water for a groundwater exchange as described in Section 1.6.2. In the No Action Alternative, 93,300 acre-feet would be delivered to Utah Lake (82,100 acre-feet for exchange to Jordanelle Reservoir and 11,200 acre-feet of M&I water).

1.2.7 Colorado River Storage Project Power Use

Pumping facilities in various components of the Bonneville Unit will require electrical power for their operation. Under the terms of the Colorado River Storage Project (CRSP) Act of April 11, 1956 (Public Law 84-485), a block of CRSP power has been reserved for operation of participating projects of the CRSP. The average annual power requirements for the Proposed Action that will be met by CRSP consist of 12,275 kilowatts of capacity and 15,777,000 kilowatt-hours of energy. Power requirements for other alternatives would be equal to or less than these, as describes elsewhere in this chapter. The Bonneville Unit components to be furnished with CRSP power and their respective power requirements are listed in Table 1-2. Additional information on SFN System power needs is presented under the discussion of the operational aspects of the Proposed Action and MCAP Alternative.

Table 1-2
Bonneville Unit Operating Power Requirements

Bonneville Unit Component	Electrical Capacity Requirement (kW)	Electrical Energy Requirement (kWh/year)
SFN System	4,900	6,927,000
M&I System	4,975	5,850,000
Wasatch County Water Efficiency Project	2,400	3,000,000
Total	**12,275**	**15,777,000**

Note: kW = kilowatts. kWh/year = kilowatt-hours per year.

1.3 Purpose and Need

Water conveyance facilities are needed to 1) deliver transbasin Bonneville Unit supplemental irrigation water to southern Utah and eastern Juab Counties, 2) deliver transbasin Bonneville Unit M&I water to Utah Lake in exchange for M&I water developed from groundwater and springs in southern Utah County, and 3) deliver water to Utah Lake for exchange to Jordanelle Reservoir.

The SFN System has been planned to 1) meet the water requirements of irrigators, communities, and individuals in southern Utah and eastern Juab Counties; 2) cooperate with local water suppliers and natural resource management agencies in the joint use of facilities to deliver all available supplies; 3) minimize project costs to the federal government, the CUWCD, and the local water users; 4) improve water use efficiency; and 5) mitigate unavoidable adverse environmental impacts of the SFN System, Bonneville Unit, and earlier federal USBR projects to the extent possible through the layout and operation of the project facilities to restore and conserve fish and wildlife resources and provide associated recreational opportunities.

1.3.1 Agricultural Water

Southern Utah and eastern Juab Counties contain irrigated lands that presently experience shortages of irrigation water in late summer. The productivity of these lands could increase with a dependable full season water supply. In addition, eastern Juab County contains land that has been developed for agriculture but is currently not irrigated because it lacks an irrigation water supply. Irrigation water would greatly increase the productivity of this land. The total irrigation water demand for these lands, the present useable supply, and the resulting demand for CUP water, which is 86,100 acre-feet, are listed in Table 1-3. The estimated water demand is based on irrigation efficiencies attainable with rehabilitated distribution systems and up-to-date on-farm irrigation practices. The amount of CUP irrigation water to be delivered by the Proposed Action is discussed in Section 1.6.2.1. Bonneville Unit conveyance facilities need to be constructed to deliver the Bonneville Unit transbasin diversion water to the agricultural lands in southern Utah and eastern Juab Counties.

Table 1-3
SFN System Agricultural Water Demands

Area	Demand (acre-feet)	Present Usable Supply (acre-feet)	CUP Water Demand (acre-feet)
Spanish Fork and Santaquin Areas	145,200	108,600	36,600
Elberta Area	20,000	16,300	3,700
Mona-Nephi Area	68,500	28,800	39,700
West Mona Area	6,100	0	6,100
Total	**239,800**	**153,700**	**86,100**

1.3.2 Municipal and Industrial Water

Southern Utah County communities within the SFN System service area include Mapleton, Springville, Elk Ridge, Woodland Hills, Payson, Salem, Santaquin, Spanish Fork, Goshen, and Genola. These communities and the surrounding unincorporated areas obtain their M&I water supplies from wells and springs under established water rights. Their average annual M&I water demand is projected to increase from 21,850 acre-feet in 1994 to 51,200 acre-feet in 2035, an increase of 29,350 acre-feet. This projection is from a report entitled *Water Requirement and Facility Study for South Utah County* prepared for the SWUA and CUWCD (Parsons Engineering

Science, Inc. 1995). Based on this analysis and public involvement and scoping, 11,200 acre-feet of M&I water would be provided to southern Utah County by the SFN System.

The estimated increase in M&I demand of 29,350 acre-feet to the year 2035 is expected to be met by water from existing wells, springs, city-owned non-potable surface water supplies, conversion of irrigation water from properties developed for other purposes, and imported water. The projected average annual increased M&I demand could be met by 8,800 acre-feet of existing water supplies, 9,350 acre-feet of agricultural conversion water, and 11,200 acre-feet of Bonneville Unit water delivered by the SFN System. A conversion of SVP or CUP water from irrigation use to M&I use would require a contractual agreement between CUWCD and/or SWUA and DOI and would require additional NEPA compliance.

1.4 Overview of the Proposed Action and Alternatives

The Proposed Action would provide irrigation water to southern Utah and eastern Juab Counties to supplement an existing, but inadequate, local supply. It would also provide additional M&I water to Utah Lake for exchange to communities in southern Utah County for future growth and would deliver Bonneville Unit water from Strawberry Reservoir to Utah Lake for exchange to Jordanelle Reservoir. The Proposed Action would accomplish these objectives through the completion of the Diamond Fork System and construction of the SFN System.

The facilities proposed for construction under the Proposed Action would consist of the "Diamond Fork Tunnel Alternative" to form the hydraulic connection between the completed Diamond Fork System facilities and the Main Conveyance Aqueduct to convey the water from the end of the Diamond Fork System to southern Utah and eastern Juab Counties. The "Diamond Fork Tunnel Alternative" would consist of a series of tunnels and pipelines that would convey water through the mountainous terrain of the Diamond Fork Canyon and various tributary canyons (Diamond Fork drainage) in the Uinta National Forest. The old Strawberry Tunnel would be used to convey project water, both fishery flows and occasionally water needed for irrigation, M&I, and habitat maintenance. The Main Conveyance Aqueduct would be a pipeline beginning at the confluence of Diamond Fork Creek and the Spanish Fork River, running down Spanish Fork Canyon and along the east benches of southeastern Utah Valley and eastern Juab Valley to the Nephi area. Associated features of the Main Conveyance Aqueduct would include turnouts, regulating ponds, a pumping plant, and a 300 acre-foot emergency and regulating reservoir in Juab Valley. Bonneville Unit water would be provided to the west Mona area by pumping from Mona Reservoir and to the Elberta area by releasing water from Mona Reservoir. These operating plans and facilities are described in more detail in Section 1.6, Description of the Proposed Action and Alternatives.

The Main Conveyance Aqueduct would be sized to convey a portion of the SVP water from Strawberry Reservoir for agricultural use in the Spanish Fork area of southern Utah County. The additional capacity to convey SVP water was added after consideration of potential cost savings that would result from the joint use of the Main Conveyance Aqueduct. The Spanish Fork River would be used to convey Bonneville Unit water to Spanish Fork River irrigation companies and Utah Lake as well as SVP water not carried in the Main Conveyance Aqueduct. The Diamond Fork System, which conveys the water to the SFN System, would be operated to maintain certain minimum streamflows in Sixth Water and Diamond Fork Creeks. The CUWCD would construct, operate, and maintain the SFN System.

Five alternatives that differ from the Proposed Action were formulated and analyzed. One alternative (the MCAPW-DFT Alternative) has essentially the same facilities as the Proposed Action, but would not convey SVP water in the Main Conveyance Aqueduct. Four alternatives (the MCAP, MCAPW, MCATC, and MCAT Alternatives) would each use Monks Hollow Dam and Reservoir in Diamond Fork Canyon (proposed as part of the Diamond Fork System, but not needed in the SFN System Proposed Action) to regulate transbasin diversions from Strawberry Reservoir. Variations among these four alternatives involve the operation of the Main Conveyance Aqueduct with and without conveyance of SVP water and variations in aqueduct alignment between

Spanish Fork Canyon and southeastern Utah Valley (with and without a tunnel through Loafer Mountain east of Salem).

Finally, a "no action" alternative was formulated in which most of the Bonneville Unit water from Strawberry Reservoir would be delivered to Utah Lake and the delivery of irrigation water would be limited to an amount that could be diverted from the Spanish Fork River by existing diversion facilities. The Proposed Action and the alternatives are as follows:

Proposed Action	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative." This proposed plan would convey both Bonneville Unit and SVP water in SFN System facilities and would avoid construction of Monks Hollow Dam in Diamond Fork Canyon
MCAPW-DFT Alternative	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative" and Without SVP Water Conveyance Alternative. This alternative addresses the case in which SVP water is not conveyed in SFN System facilities and would also avoid construction of Monks Hollow Dam in Diamond Fork Canyon.
MCAP Alternative	Main Conveyance Aqueduct with Monks Hollow Dam Alternative. This alternative addresses the case in which both Bonneville Unit and SVP water are conveyed in SFN System facilities and Monks Hollow Dam would be constructed in Diamond Fork Canyon to provide regulatory storage.
MCAPW Alternative	Main Conveyance Aqueduct with Monks Hollow Dam and Without SVP Water Conveyance Alternative. This alternative addresses the case in which SVP water would not be conveyed in SFN System facilities and Monks Hollow Dam would be constructed in Diamond Fork Canyon to provide regulatory storage.
MCATC Alternative	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam Alternative. This alternative addresses the case in which both Bonneville Unit and SVP water would be conveyed in SFN System facilities and Monks Hollow Dam would be constructed in Diamond Fork Canyon to provide regulatory storage, but the Main Conveyance Aqueduct would be tunnelled through Loafer Mountain.
MCAT Alternative	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam and Without SVP Water Conveyance Alternative. This alternative addresses the case in which SVP water would not be conveyed in SFN System facilities, Monks Hollow Dam would be constructed in Diamond Fork Canyon to provide regulatory storage, and the Main Conveyance Aqueduct would be tunnelled through Loafer Mountain.
No Action Alternative	No SFN System, but the Diamond Fork System would be completed with Three Forks Dam and Reservoir. With these facilities, this alternative would provide M&I water via exchange with new drinking water wells and a limited amount of irrigation water to southern Utah County, and sufficient water for Utah Lake to make the Jordanelle Reservoir exchange for the Bonneville Unit M&I System.

The configurations of the Proposed Action and each of the alternatives, including the proposed completion of the Diamond Fork System are shown in Table 1-4.

Table 1-4 General Comparison of Alternatives							
Alternatives	Facilities						
	Syar Tunnel	Monks Hollow Dam	"Diamond Fork Tunnel Alternative"	Three Forks Dam	Main Conveyance Aqueduct	High Line Canal Replaced	SVP Water in Main Conveyance Aqueduct
Proposed Action	Yes	No	Yes	No	Yes	Yes	Yes
MCAPW-DFT Alternative	Yes	No	Yes	No	Yes	No	No
MCAP Alternative	Yes	Yes	No	No	Yes	Yes	Yes
MCAPW Alternative	Yes	Yes	No	No	Yes	No	No
MCATC Alternative	Yes	Yes	No	No	Yes	Yes*	Yes
MCAT Alternative	Yes	Yes	No	No	Yes	No	No
No Action Alternative (No SFN System)	Yes	No	No	Yes	No	No	NA
*Under the MCATC Alternative, the High Line Canal would be partially replaced by distribution pipelines.							

1.5 Background and History

Bonneville Unit planning and development has spanned several decades. On the basis of various planning reports prepared by the USBR in the 1950s, Congress enacted the Colorado River Storage Project Act in 1956, authorizing construction of the Bonneville Unit as a unit of the CUP. In 1964, the USBR completed the *Bonneville Unit DPR* (USBR 1964), with an addendum in 1965 (USBR 1965). The original document prepared the way for the start of construction of the Bonneville Unit, which began in 1965. Construction proceeded on all the segments of the Bonneville Unit except the I&D System, which depended on completion of various other systems. To update and consolidate the project plan, the USBR prepared the 1988 DPR (USBR 1988a).

In October 1992, CUPCA was signed into law. With CUPCA, Congress provided direction for the completion of the CUP with certain modifications of prior plans. Congress considered the 1988 DPR (USBR 1988a) final and required that an updated DPR be prepared for the Bonneville Unit, authorized the CUWCD to complete the CUP, and empowered the CUWCD to be considered a "Federal Agency" for the purpose of complying with NEPA and other environmental regulations. It also increased the funding ceiling to complete the CUP and authorized a funding ceiling for various fish and wildlife mitigation and enhancement measures to compensate for the impacts of all CUP developments.

1.5.1 SFN System

The SFN System is an alternative feature to an earlier plan referred to as the I&D System. The I&D System was planned to convey and distribute Colorado River Basin water, stored in Strawberry Reservoir, to agricultural lands in the Bonneville Basin. The primary feature of the I&D System was a conveyance system from the confluence of Diamond Fork Creek and the Spanish Fork River, down Spanish Fork Canyon, and south along the bench areas to agricultural lands in southern Utah and eastern Juab Counties and to Sevier Bridge Reservoir on the Sevier River.

As described in the 1964 *Bonneville Unit DPR* (USBR 1964), the proposed water service was to extend as far south as the Nephi area and included the Mosida area lands lying southwest of Utah Lake. In 1968, service to the Mona-Nephi and Mosida areas was reduced in scope, and the proposed water service was extended south to the Sevier River Basin by extending the conveyance system to the Sevier Bridge Reservoir on the Sevier River.

In 1984, following a review led by the State of Utah, two dikes, which would have reduced the surface area of Utah Lake and evaporation losses thereby, were eliminated from the Bonneville Unit. The Utah Lake water saved by reducing evaporation losses was to have been exchanged to Jordanelle Reservoir to provide the M&I water supply for Salt Lake County and northern Utah County. The CUWCD purchased water rights within Utah Lake to replace the water that was to have been utilized as a result of the reduced evaporation. Under the SFN System, the federal government would purchase these water rights and incorporate them into the water supply for the total Bonneville Unit.

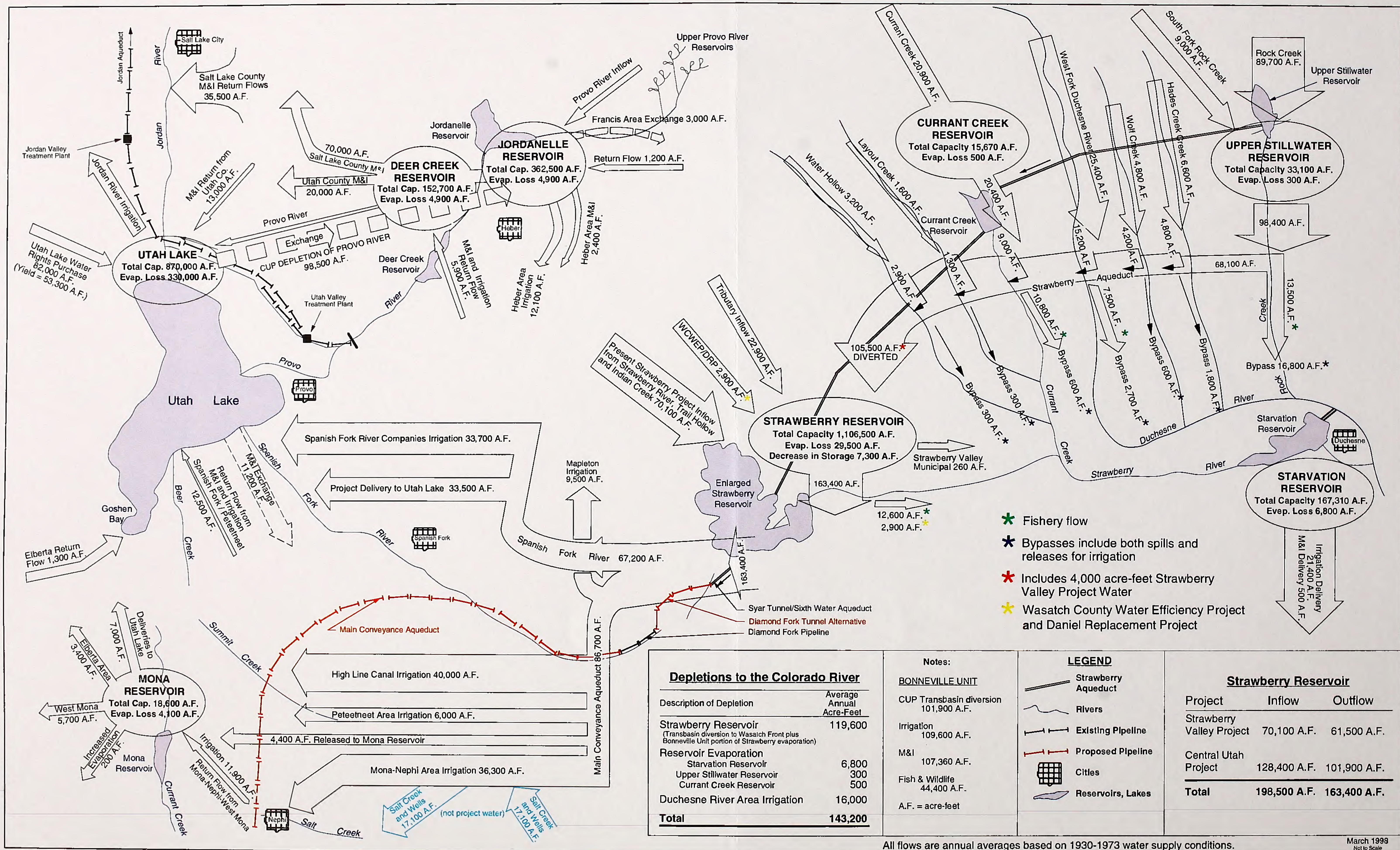
CUPCA authorized alternatives in the plan to convey Bonneville Unit water to southern Utah and eastern Juab Counties. Reduction of Bonneville Unit water available for diversion from Strawberry Reservoir (from 142,500 acre-feet to 101,900 acre-feet) has resulted in a greater emphasis on water conservation. Local irrigation companies and other local water distributors have developed plans to upgrade their water distribution systems, thus reducing losses and providing more efficient operation. Individual irrigators are also planning improvements of their irrigation systems to increase the efficiency with which the local supplies and Bonneville Unit water would be used.

CUPCA eliminated various features of the earlier I&D System plan, including water service to the Mosida area west of Utah Lake. Also legislatively directed under CUPCA, the design of the Main Conveyance Aqueduct canal sections was changed to a pipeline. This change would avoid community disruption and human-related safety hazards, eliminate the barrier to wildlife movement posed by the canal, and increase the efficiency of water deliveries.

In the 1988 DPR (USBR 1988a), the I&D System included delivery of supplemental irrigation water to the Sevier River Basin. CUPCA authorized construction of this plan, but also contained a provision that in the event the I&D System's Main Conveyance Aqueduct did not extend to the Sevier River Basin, funding would be provided for construction of alternate features to deliver irrigation water to lands in the Utah Lake drainage basin. After enactment of CUPCA, Millard and Sevier Counties petitioned for de-annexation from the CUWCD, which, when ratified by the Fourth District Court, excluded the counties from the CUWCD. The I&D System was subsequently replaced by the Spanish Fork Canyon-Nephi Irrigation System because it would no longer convey Bonneville Unit water outside the Utah Lake drainage basin. The agricultural lands served by the SFN System (see Map 1-2) in southern Utah County would be from Springville south to Santaquin and in eastern Juab County from the Utah-Juab county line to 3 miles south of the city of Nephi, including the west Mona area. The southern Utah County area also includes lands in the Elberta area.

1.5.2 Diamond Fork System

The partially completed Diamond Fork System is the link between Strawberry Reservoir and the proposed SFN System. It conveys water from Strawberry Reservoir through the Wasatch Mountain crest, across Rays Valley, into Sixth Water Creek, and through Diamond Fork Canyon to the confluence of Diamond Fork Creek and the Spanish Fork River. Two major segments of the Diamond Fork System have been completed, but one (the Diamond Fork Pipeline) is nonfunctional; its use awaits completion of the Diamond Fork System.



Depletions to the Colorado River

Description of Depletion	Average Annual Acre-Feet
Strawberry Reservoir (Transbasin diversion to Wasatch Front plus Bonneville Unit portion of Strawberry evaporation)	119,600
Reservoir Evaporation	
Starvation Reservoir	6,800
Upper Stillwater Reservoir	300
Currant Creek Reservoir	500
Duchesne River Area Irrigation	16,000
Total	**143,200**

Notes:

BONNEVILLE UNIT

CUP Transbasin diversion 101,900 A.F.

Irrigation 109,600 A.F.

M&I 107,360 A.F.

Fish & Wildlife 44,400 A.F.

A.F. = acre-feet

Strawberry Reservoir

Project	Inflow	Outflow
Strawberry Valley Project	70,100 A.F.	61,500 A.F.
Central Utah Project	128,400 A.F.	101,900 A.F.
Total	**198,500 A.F.**	**163,400 A.F.**

All flows are annual averages based on 1930-1973 water supply conditions.

March 1998
Not to Scale

Figure 1-2
Distribution of Bonneville Unit and Strawberry Valley Project Water

Diamond Fork System facilities that have been constructed are the Syar Tunnel inlet, Syar Tunnel, Sixth Water Aqueduct, and Diamond Fork Pipeline. The Syar Tunnel and Sixth Water Aqueduct together form a continuous 7.3-mile conduit from Strawberry Reservoir to Sixth Water Creek. The Sixth Water Aqueduct currently discharges water into Sixth Water Creek approximately 3.5 miles upstream of its confluence with Diamond Fork Creek. The 96-inch-diameter Diamond Fork Pipeline has been completed along Diamond Fork Creek between Monks Hollow and the confluence of the creek with the Spanish Fork River, but will not be operable until upstream facilities are constructed to divert water into it. The purpose of the Diamond Fork Pipeline is to deliver Bonneville Unit and SVP water that is in excess of the flow needed in the Diamond Fork Creek channel to maintain aquatic and riparian habitat and then to deliver the bypassed water under pressure to the proposed SFN System Main Conveyance Aqueduct.

The complete array of facilities in the Diamond Fork System differs among the proposed SFN System implementation plan and the alternatives presented in this report. Under the Proposed Action and MCAPW-DFT Alternative, the Diamond Fork System would be completed by constructing a series of tunnels and pipelines to connect the outlet of the Sixth Water Aqueduct to the upstream end of the Diamond Fork Pipeline. These features are called the "Diamond Fork Tunnel Alternative," an alternative to Monks Hollow Dam and Reservoir, which were previously proposed in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990). The "Diamond Fork Tunnel Alternative" is part of the Proposed Action in this DEIS.

Under the MCAP, MCAPW, MCATC, and MCAT Alternatives, Monks Hollow Dam and Reservoir would be constructed between Sixth Water Aqueduct and the Diamond Fork Pipeline. Monks Hollow Dam would be constructed on Diamond Fork Creek immediately downstream of Monks Hollow, approximately 7.4 miles upstream of the confluence of Diamond Fork Creek and the Spanish Fork River. The dam would form the 33,100 acre-foot Monks Hollow Reservoir, which would extend upstream from the dam for approximately 2.4 miles to the confluence of Sixth Water Creek and Diamond Fork Creek, known as Three Forks. Monks Hollow Dam and Reservoir are described under the MCAP Alternative.

Under the No Action Alternative, Three Forks Dam and Reservoir would be constructed between Sixth Water Aqueduct and the Diamond Fork Pipeline. Three Forks Dam, a 60-foot-high dam, would be constructed on Diamond Fork Creek immediately downstream of Three Forks. The Diamond Fork Pipeline would be extended upstream about 2.5 miles to Three Forks Dam. Three Forks Dam and Reservoir are described under the No Action Alternative.

The Diamond Fork System has been the subject of previous NEPA compliance activity, which included preparation of the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) issued on October 4, 1984. That document was supplemented by the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990) on February 22, 1990, which culminated in a Record of Decision signed by the USBR Commissioner in July 1990 and a subsequent Record of Decision signed by the DOI Assistant Secretary in January 1995.

The completion and operation of the Diamond Fork System under the Proposed Action presented in this DEIS differ from the Diamond Fork System Proposed Action presented in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990). The Proposed Action in the 1990 document included the construction of Monks Hollow Dam and Reservoir. Under the current Proposed Action in this DEIS, the "Diamond Fork Tunnel Alternative" would be constructed instead of Monks Hollow Dam and Reservoir. Certain minimum flows would be provided in Sixth Water and Diamond Fork Creeks. The minimum flows consist of 25 and 32 cubic feet per second (cfs), respectively, in upper Sixth Water Creek, and winter and summer minimum flows of 60 and 80 cfs, respectively, in lower Diamond Fork Creek. The current Proposed Action would include the infrequent (1 percent of the time) release of additional water through Strawberry Tunnel when irrigation water demand is exceptionally high, rather than the 25 and 32 cfs minimum releases. There would be need for Congressional modification to CUPCA to use the old Strawberry Tunnel for irrigation deliveries. The flow rate through Syar Tunnel under the current Proposed Action would also be higher under the Diamond Fork System Proposed Action in the *Final*

Supplement to the FEIS, Diamond Fork System (USBR 1990) to compensate for the absence of the regulating storage that Monks Hollow Reservoir would provide.

Generally, the Diamond Fork System operating plan under the Proposed Action and the action alternatives in this DEIS would be similar to the Proposed Action in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990). Syar Tunnel and Sixth Water Aqueduct would be the primary means of making the transbasin diversion from Strawberry Reservoir to the SFN System. However, supplemental releases from Strawberry Reservoir would be made through Strawberry Tunnel. The departures from the Proposed Action in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990) would provide improved aquatic and riparian habitat along Sixth Water and Diamond Fork Creeks. Environmental compliance for these changes is included in this DEIS.

1.6 Description of the Proposed Action and Alternatives

This section describes the Proposed Action and alternatives. Also discussed are alternatives considered but eliminated from detailed analysis. These focus primarily on alternative ways to complete the Diamond Fork System and alternative uses of the SFN System water supply.

1.6.1 Alternatives Considered But Eliminated from Detailed Analysis

When the Proposed Action and the alternatives were formulated, other alternatives were also examined but found to be infeasible and thus eliminated from detailed analysis. This section summarizes these other alternatives and the reasons for their elimination, per 40 CFR 1502.14(a). Generally, they were eliminated because they would result in one or more of the following: 1) they would cause severe environmental impacts; 2) they would not meet the purposes and needs of the SFN System discussed in Section 1.3.1; 3) they would require additional legislation; 4) they are not economically viable; 5) they do not meet the requirement for binding water contracts; 6) they would require a reallocation of the Bonneville Unit costs and new repayment contracts; and/or 7) they would require a reallocation of the Bonneville Unit water supply.

1.6.1.1 Alternative Ways to Complete the Diamond Fork System

The Diamond Fork System has not yet been completed; it lacks facilities between the outlet of Sixth Water Aqueduct and the upper end of the Diamond Fork Pipeline. A prerequisite is that such facilities must be able to provide seasonal minimum flows of 60 cfs and 80 cfs in lower Diamond Fork Creek and must maximize the ability of the Diamond Fork Pipeline to bypass high summer flows around upper Diamond Fork Creek to enhance aquatic and riparian habitat along the creek. As indicated earlier in Section 1.5.2, the Diamond Fork System is vital to the operation of the SFN System, and the configuration of the Diamond Fork System would affect the operational processes of the SFN System.

Five alternatives were examined to determine their feasibility and practicality in meeting the operational objectives of the Diamond Fork System. These alternatives are summarized in the following subsections, together with the effects they would have on the SFN System. They were eliminated from further consideration for reasons as described below. Three of the discarded alternatives included direct pipeline and/or tunnel connections to the outlet of Sixth Water Aqueduct as a means of diverting water into the Diamond Fork Pipeline. They were rejected in favor of the "Diamond Fork Tunnel Alternative" direct connection in the Proposed Action and the MCAPW-DFT Alternative. The other two discarded alternatives included a diversion dam on Diamond Fork Creek at Three Forks. They were rejected in favor of the originally planned Monks Hollow Dam and Reservoir under the MCAP, MCAPW, MCATC, and MCAT Alternatives, which were identified in Section 1.4.

1.6.1.1.1 Alternative of Connecting the Diamond Fork Pipeline Directly to the Sixth Water Aqueduct with a Pipeline Along Sixth Water Creek. In this alternative, a pipeline would convey water from the outlet of Sixth Water Aqueduct to the Diamond Fork Pipeline. The additional pipeline would begin at the outlet of Sixth Water Aqueduct, run down Sixth Water Creek to Three Forks, and then run along Diamond Fork Creek to Monks Hollow, where it would connect to the upstream end of the existing Diamond Fork Pipeline. The pipeline would be 96 inches in diameter and approximately 6.7 miles long and would have a capacity of 600 cfs.

A 60 cfs turnout would be constructed at the outlet of Sixth Water Aqueduct to release aqueduct flows that exceed the capacity of the additional pipeline. A 90 cfs turnout would be constructed at the end of the additional pipeline to release tunnel flow in excess of the Diamond Fork Pipeline capacity to Diamond Fork Creek at Monks Hollow.

To meet summer water demand in southern Utah and eastern Juab Counties, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be supplemented with the transbasin diversion of water through the existing Strawberry Tunnel. The Strawberry Tunnel, which is presently in poor condition because of its advanced age, would be rehabilitated to provide 200 cfs of capacity from Strawberry Reservoir to Sixth Water Creek. The use of Strawberry Tunnel in this manner would require Congressional modification of certain provisions of CUPCA that prohibit such use.

This alternative was eliminated because there is insufficient space in the Sixth Water Creek canyon between the Sixth Water Aqueduct and Three Forks to build a large-diameter pipeline without excessive environmental damage and construction cost. The winding canyon is narrow with steep hillside slopes rising from both sides of the creek bottom. Construction of a 96-inch-diameter pipeline would require excavating benches into a side of the canyon for pipe burial and for construction equipment access.

1.6.1.1.2 Alternative of Connecting the Diamond Fork Pipeline Directly to the Sixth Water Aqueduct with a Pipeline Along Upper Diamond Fork Creek and a Tunnel Under Tanner Ridge. In this alternative, water from Sixth Water Aqueduct would be conveyed in a tunnel under Tanner Ridge to upper Diamond Fork Canyon; then a pipeline along upper Diamond Fork Creek would convey the water from the tunnel outlet to the existing Diamond Fork Pipeline. The tunnel outlet would be about 3.7 creek-miles upstream of Three Forks. The tunnel would be 96 inches in diameter and about 1.2 miles long. The pipeline along Diamond Fork Creek would be 96 inches in diameter and about 6.4 miles long. Both the tunnel and the pipeline would have a maximum flow rate of 660 cfs.

At the point where the pipeline connects to the existing Diamond Fork Pipeline turnout to Diamond Fork Creek, a turnout to Diamond Fork Creek would be constructed to maintain minimum flows in lower Diamond Fork Creek and to release irrigation water in excess of the Diamond Fork Pipeline capacity to Diamond Fork Creek.

To meet summer water demand in southern Utah and eastern Juab Counties, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be supplemented with groundwater pumping to enable the SFN System to meet summer water demand. Twenty-two wells would be drilled in southern Utah County to provide 11,200 acre-feet of M&I water annually. The groundwater pumped would be replaced by delivery of 11,200 acre-feet of Strawberry Reservoir water to Utah Lake in exchange for the reduction in springflow into the lake caused by the groundwater pumping. Also, 18 wells would be drilled in eastern Juab County to provide additional water during the summer months when irrigation demand is at its highest. The pumped groundwater would be replaced by recharging a like amount of Strawberry Reservoir water in the areas where the pumping occurs. The recharge would be made in the fall when capacity exists in the Main Conveyance Aqueduct.

This alternative was eliminated because there is insufficient space in the upper Diamond Fork Canyon between the tunnel outlet and Three Forks to build a large-diameter pipeline without excessive environmental damage. The winding canyon has a narrow "V"-shaped bottom with steep slopes rising from both sides of the creek.

Construction of a 96-inch-diameter pipeline would require the total disruption and rechannelization of the creek for construction equipment access and pipe burial.

1.6.1.1.3 Alternative of Connecting the Diamond Fork Pipeline Directly to the Sixth Water Aqueduct with a Single Long Tunnel. In this alternative, water from the outlet of Sixth Water Aqueduct would be conveyed directly to the Diamond Fork Pipeline by a 5.1-mile tunnel. The tunnel would begin along Sixth Water Creek opposite the outlet of Sixth Water Aqueduct and would end at a point near the upstream end of the existing Diamond Fork Pipeline. A 500-foot-long siphon would be constructed under Sixth Water Creek to connect the tunnel to the outlet of Sixth Water Aqueduct, and a 500-foot-long pipeline would be constructed to connect the end of the tunnel to the start of the Diamond Fork Pipeline. The tunnel would have a diameter of 96 inches and a capacity of 600 cfs.

A 60 cfs turnout would be constructed at the outlet of Sixth Water Aqueduct to release aqueduct flows that exceed the capacity of the tunnel. A 90 cfs turnout would be constructed at the end of the tunnel to release tunnel flow in excess of the Diamond Fork Pipeline capacity to Diamond Fork Creek at Monks Hollow.

To meet summer water demand in southern Utah and eastern Juab Counties, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be supplemented with the transbasin diversion of water through the existing Strawberry Tunnel. The Strawberry Tunnel would be rehabilitated to provide 200 cfs of capacity from Strawberry Reservoir to Sixth Water Creek. The use of Strawberry Tunnel in this manner would require Congressional modification of certain provisions of CUPCA that prohibit such use.

This alternative was eliminated because of the high cost of tunnel construction and because the higher flows of 200 cfs in Sixth Water Creek would occur on a more frequent basis in the irrigation season and only infrequently under the Proposed Action.

1.6.1.1.4 Alternative of Completing the Diamond Fork System with a Diversion Dam at Three Forks Having Zero Active Capacity and 2,000 Acre-Foot Inactive Capacity. The dam at Three Forks would be a diversion structure that would divert flows released from Strawberry Reservoir into a pipeline approximately 120 inches in diameter and 14,000 feet long to convey water from the dam to the Diamond Fork Pipeline. The elevation of the diversion dam would provide a hydraulic gradient elevation of 5,555 feet at Monks Hollow. Three Forks Dam would have a height of 105 feet and a crest length of 500 feet. The surface area of the reservoir would be in the range of 40 to 50 acres. The diversion pool behind the dam would have an inactive capacity of about 2,000 acre-feet. This smaller reservoir would reduce the amount of sediment trapped in the reservoir and would result in more sediment in the Diamond Fork Pipeline and in Diamond Fork Creek.

The maximum flow rate through Syar Tunnel and Sixth Water Aqueduct under this alternative would be 600 cfs. That flow rate, together with the release through Strawberry Tunnel for streamflow maintenance, would not meet peak summer water delivery requirements. Thus, additional facilities would be used to increase the water delivery rate. Strawberry Tunnel would be rehabilitated to deliver 200 cfs, and wells having a combined capacity of 80 cfs would be drilled in Juab Valley to meet the peak summer delivery requirement.

This alternative was eliminated for the following reasons:

- The transbasin diversion of 200 cfs on a more frequent basis during the irrigation season through the Strawberry Tunnel would preclude the restoration of upper Sixth Water Creek as authorized in Section 307 of CUPCA.

- The 800 cfs that would be conveyed in Sixth Water Creek under this alternative would exceed the capacity of the stream channel to carry that flow. Initially, the flow would scour the creek channel and pick up sediment that would cause deposits in the Diamond Fork Pipeline, the SFN System, and Diamond Fork

Creek. After the initial scouring, the sediment pickup would decrease, but would continue to be a problem because of the reduced reservoir retention time.

- A major groundwater development program in Juab Valley would pose a significant risk to wetlands. There are presently approximately 7,950 acres of wetlands in eastern Juab Valley (refer to Chapter 3, Table 3.4-2) that, in part, owe their origins to irrigated agriculture. Recent studies by the U.S. Geological Survey indicate that additional pumping would deplete the groundwater available to the wetlands habitat.

In all probability, the loss of wetlands in Juab Valley because of groundwater pumping would be unmitigatable. The high cost of replacement land and apparent infeasibility of finding and purchasing the required water supply to create replacement wetlands and annual maintenance would be prohibitive. A second risk would be that serious institutional constraints exist in that the State Engineer has designated the groundwater basin in Juab Valley as a closed basin in terms of drilling new wells. A third risk factor is that landowners in Juab Valley who rely on groundwater pumping to meet part of their irrigation needs have not been supportive of any plans to pump groundwater above what has been done historically. They cite the fact that well interference already exists in the valley and the situation would be aggravated with additional pumping. Finally, without groundwater pumping, the plan does not have facilities sufficient to provide peak water deliveries to meet irrigation demands.

1.6.1.1.5 Alternative of Completing the Diamond Fork System with a Dam and Reservoir at Three Forks, Consisting of a 2,000 Acre-Foot Inactive Pool and an 11,000 Acre-Foot Active Pool. This alternative would replace the proposed Monks Hollow Dam and Reservoir with a smaller dam and reservoir upstream of Monks Hollow on Diamond Fork Creek at Three Forks (Three Forks Reservoir). The dam would be 225 feet high with a reservoir surface area of 325 acres. Three Forks Reservoir would have an active capacity of 11,000 acre-feet and sediment storage capacity of 2,000 acre-feet. This 11,000 acre-foot active capacity is the distinguishing difference from the No Action Alternative. This alternative is useful because Three Forks Reservoir would provide a hydraulic head and peaking capacity similar to that which would be provided by Monks Hollow Reservoir. This alternative would require an additional 14,000-foot-long pipeline connecting Three Forks Dam with the Diamond Fork Pipeline. This alternative was eliminated for the following reasons:

- The reservoir, inundation, and operational impacts with the Three Forks Dam and Reservoir would be similar to those of a dam and reservoir at the Monks Hollow site with a reduction in operational flexibility. NEPA compliance already exists for the proposed plan. There would be construction delays in preparing NEPA compliance documents and gathering additional design data for a dam at Three Forks.

- The 800 cfs that would be conveyed in Sixth Water Creek under this alternative would exceed the capacity of the stream channel. Initially, the flow would scour the creek channel and pick up sediment, some of which would pass through the small reservoir at Three Forks and cause deposits in the Diamond Fork Pipeline, the SFN System, and Diamond Fork Creek.

1.6.1.2 Alternative Uses of the SFN System Water Supply

The CUPCA authorized a study of the alternatives for delivering water directly from Strawberry Reservoir to the Provo River. The CUWCD investigated such alternatives and expanded the scope to include direct delivery of Strawberry Reservoir water to the Jordan Valley Water Treatment Plant in Salt Lake County. These alternatives address a different set of needs than the SFN System, including instream flow maintenance in the lower Provo River and the development of additional M&I water for Salt Lake County. The alternatives examined can be grouped into the following two categories:

- Direct delivery of M&I water to the Jordan Valley Treatment Plant
- Direct delivery of Colorado River Basin Water to the Provo River Basin

1.6.1.2.1 Direct Delivery of M&I Water to Jordan Valley Treatment Plant. In this alternative, a pipeline would be constructed from the SFN System Main Conveyance Aqueduct at the mouth of Spanish Fork Canyon to the Jordan Water Treatment Plant in Salt Lake County. Under this alternative, 33,400 acre-feet per year would be delivered to Salt Lake County for M&I purposes, with annual deliveries to southern Utah County of 27,700 and 11,200 acre-feet for irrigation and M&I, respectively, and to Utah Lake for exchange to Jordanelle Reservoir of 29,600 acre-feet. No irrigation deliveries would be made to Juab County. This alternative would require a complete reallocation of the Bonneville Unit costs and new repayment contracts with the United States. Preliminary estimates indicate that the price of this M&I water would exceed $600 per acre-foot and could be as high as $1,500 per acre-foot. The following two design options were evaluated as part of this alternative:

- Without Monks Hollow Dam and Reservoir, which would require the extension of a pipeline from the Diamond Fork Pipeline to Sixth Water Aqueduct

- With Monks Hollow Dam and Reservoir

1.6.1.2.1.1 Without Monks Hollow Dam and Reservoir. In addition to constructing a pipeline from the mouth of Spanish Fork Canyon to the Jordan Water Treatment Plant, this alternative would require connecting the existing Sixth Water Aqueduct to the Diamond Fork Pipeline. The connection between the Sixth Water Aqueduct and the Diamond Fork Pipeline would consist of a 6,000-foot tunnel extension of the Sixth Water Aqueduct northward to Diamond Fork Creek and a 27,000-foot buried pipeline along Diamond Fork Creek from the end of the tunnel extension to the beginning of the Diamond Fork Pipeline. This alternative was eliminated for the following reasons:

- It does not meet the purpose and need of the SFN System.

- It would not comply with Section 202(a)(1) of CUPCA, which authorized the construction of a pipeline to serve the Utah Lake drainage basin, and would, therefore, require additional legislation (i.e., an amendment to CUPCA).

- It would not allow the CUWCD to fulfill its contractual obligations to supply Bonneville Unit water to entities in Utah and Juab Counties. Binding contracts have already been negotiated with these entities pursuant to Section 202(a)(1)(C) of CUPCA.

- No entity in Salt Lake County eligible to contract for Bonneville Unit water has indicated a willingness to do so, and therefore, the requirements of Section 202(a)(1)(C) for binding contracts would not be met.

- It would not be economically viable because of the high cost that would be associated with this M&I water.

- It would require a complete reallocation of the Bonneville Unit costs and new repayment contracts with the United States.

1.6.1.2.1.2 With Monks Hollow Dam and Reservoir. In addition to constructing a pipeline from the mouth of Spanish Fork Canyon to the Jordan Water Treatment Plant, this alternative would require a storage facility such as Monks Hollow Dam and Reservoir. This alternative was eliminated for the same reasons cited in Section 1.6.1.2.1.1.

1.6.1.2.2 Direct Delivery of Colorado River Basin Water to the Provo River Basin. The CUWCD conducted a study of water availability and potential physical alternatives for direct delivery from the Colorado River Basin to the Provo River Basin. The alternatives feature differing approaches to the formulation of the Bonneville Unit itself, dealing with different routing and proposed uses of the Bonneville Unit water developed in Strawberry

Reservoir. The alternatives were grouped according to the section of the Provo River to which they would deliver water. The alternatives are summarized in Table 1-5. More complete descriptions of these alternatives are presented in *Final Report on the Direct Delivery of Colorado River Basin Water to the Provo River Basin* (CUWCD 1997c), which was required under Section 202(a)(5) of CUPCA. A draft of the report was distributed to federal and state agencies, environmental groups, and others for review. Comments received were incorporated into the final report. These alternatives were eliminated from further analysis for the same reasons cited in Section 1.6.1.2.1.1.

Table 1-5
Colorado River Basin to Provo River Basin Water Conveyance Alternatives

Alternative System	Description
Above Jordanelle Dam	
Rock Creek Tunnel	From Upper Stillwater Reservoir, construct a tunnel and a pipeline to the inlet of the existing Duchesne Tunnel to convey water to the upper Provo River.
West Fork Tunnel	From the Strawberry Collection System, construct a tunnel to the South Fork of the Provo River.
North Fork Pipeline	From the Strawberry Collection System (North Fork Siphon), construct a pumping plant and pipeline to convey water to the inlet of the existing Duchesne Tunnel.
Between Deer Creek and Jordanelle Dam	
Currant Creek Tunnel	From Currant Creek Reservoir, construct a tunnel to Daniels Creek, through which the water would flow into the Heber Valley.
Wallsburg Tunnel	From Strawberry Reservoir, construct a tunnel to Round Valley and a pipeline along Main Creek, tributary to Deer Creek Reservoir.
Strawberry-Daniels Pipeline	From Strawberry Reservoir, construct a pipeline with pumping plants to convey water to Daniels Pass, where it would be released to Daniels Creek, through which it would flow to the Heber Valley.
Below Deer Creek Dam	
Spanish Fork River-Provo River Pipeline	From the confluence of Diamond Fork Creek with the Spanish Fork River, construct a pipeline down Spanish Fork Canyon and along the base of the Wasatch Mountains, past the city of Provo to the Provo River.

1.6.1.3 No New Construction Alternative

The alternative of using existing CUPCA and Bonneville Unit facilities to convey SVP and Bonneville Unit water to water users designated in the CUPCA was considered and eliminated. No new construction of facilities would be involved in this "no action–no new construction" alternative, including any remaining Diamond Fork System features. The recently completed Diamond Fork Pipeline would not be made operational and no facilities would be constructed to divert water into the pipeline. Neither Monks Hollow Dam nor Three Forks Dam would be constructed. The SFN System would not be constructed.

The SVP transbasin diversion would continue through Syar Tunnel, with an average water delivery of 61,500 acre-feet per year. The existing Sixth Water Aqueduct would deliver water from Strawberry Reservoir for the SVP, and water would be conveyed down Diamond Fork Creek and the Spanish Fork River in the same manner as is currently done.

Under this alternative, a Bonneville Unit transbasin diversion of 96,800 acre-feet would be diverted through the Syar Tunnel, delivered to users via the existing Sixth Water Aqueduct, Diamond Fork Creek, the Spanish Fork River, and existing facilities, and then flow into Utah Lake.

This "no action–no new construction" alternative was eliminated since it would not fulfill the previous federal environmental commitments; would not meet the purpose and need of the Diamond Fork and SFN Systems; would cause significant erosion to Sixth Water Creek, Diamond Fork Creek, and the Spanish Fork River; and would cause significant habitat loss (both aquatic and riparian) on Sixth Water Creek, Diamond Fork Creek, and the Spanish Fork River. Further, it would eliminate the restoration potential for Sixth Water and Diamond Fork Creeks, would prevent or inhibit the Mitigation Commission from implementing the authorized mitigation and enhancement measures in the Diamond Fork drainage, and would cause the Diamond Fork Pipeline to remain non-functional.

1.6.2 Proposed Action

The Proposed Action would include the construction, operation, and maintenance of 1) the "Diamond Fork Tunnel Alternative," a 6.1-mile series of tunnels and pipelines in the Diamond Fork drainage, to convey water from the existing Syar Tunnel and Sixth Water Aqueduct to the existing Diamond Fork Pipeline and 2) the Main Conveyance Aqueduct, a 43.6-mile-long pipeline and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. The Diamond Fork drainage consists of Diamond Fork Canyon and various tributary canyons. The locations of the "Diamond Fork Tunnel Alternative" and the Main Conveyance Aqueduct are shown in Map 1-3 and Map 1-4, respectively. The major features of the Proposed Action and alternatives are summarized in Table 1-6.

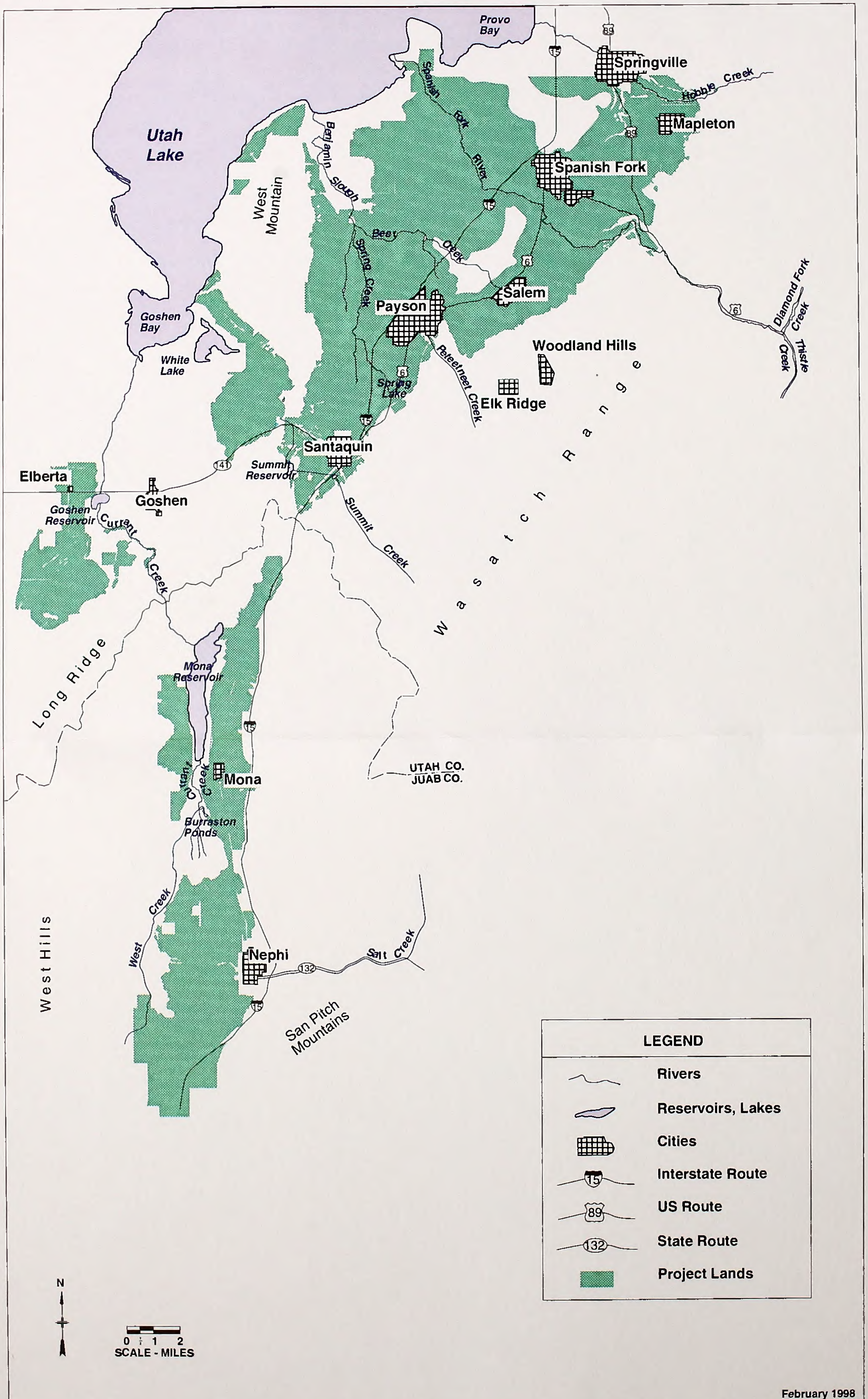
The "Diamond Fork Tunnel Alternative" would convey Strawberry Reservoir water from the existing Syar Tunnel and Sixth Water Aqueduct to the existing Diamond Fork Pipeline. The Main Conveyance Aqueduct would convey water from the terminus of the Diamond Fork Pipeline for irrigation use in southern Utah and eastern Juab Counties and for an M&I water supply in southern Utah County. The Main Conveyance Aqueduct would replace the High Line Canal from its beginning to the vicinity of Spring Lakes, south of Payson. The Proposed Action would be accompanied by related actions (local development) that would distribute the water locally.

1.6.2.1 Operation of the Proposed Action

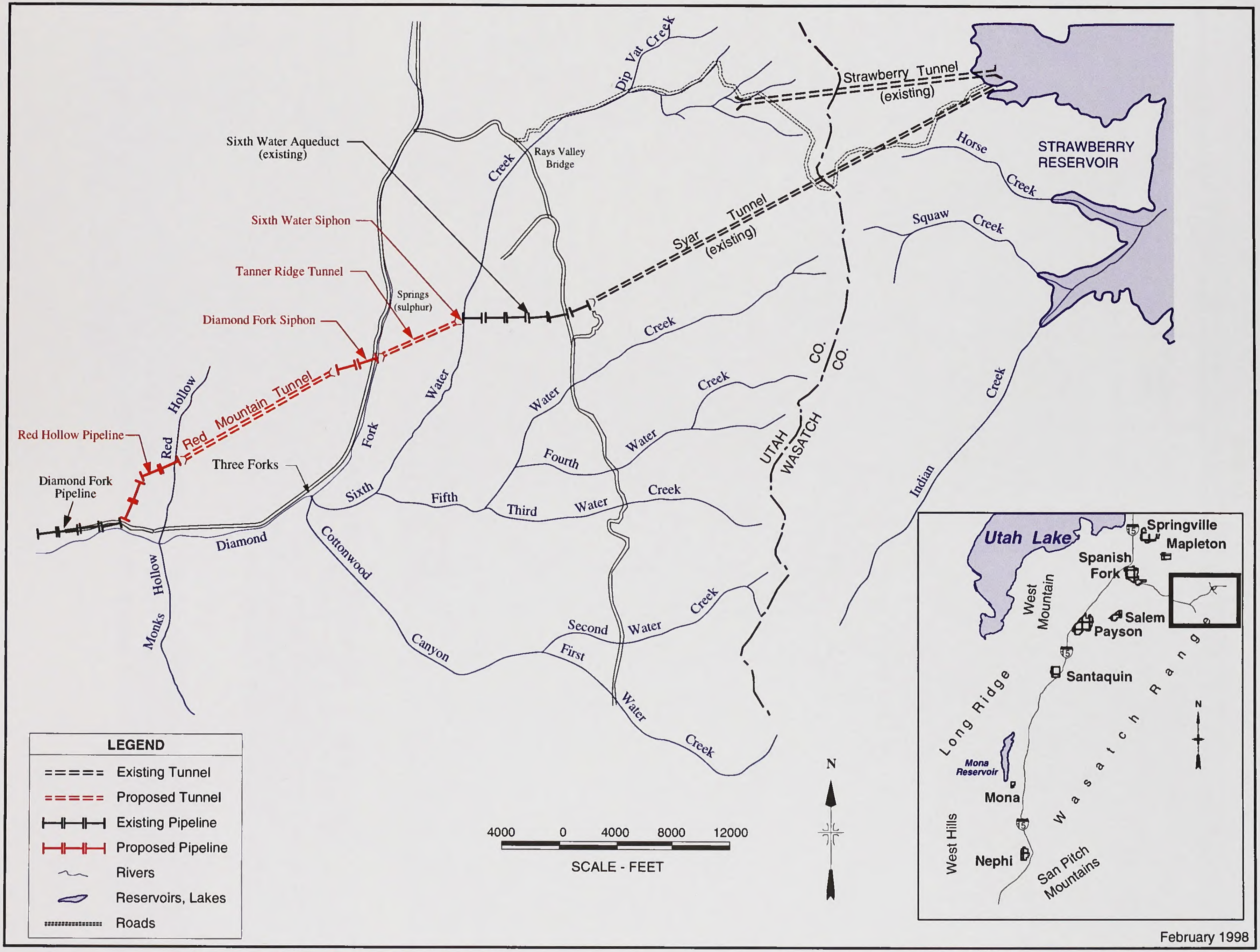
The water operation of the Proposed Action is presented schematically in Figure 1-2 (see Section 1.2.5). The average annual amounts of water shown in Figure 1-2 are the Bonneville Unit and SVP waters that originate as transbasin diversions from Strawberry Reservoir (including the return flows resulting from their use). They do not include seepage from Strawberry Tunnel or natural flows in Diamond Fork Creek or the Spanish Fork River, all of which have historically been used for irrigation. However, these natural flow and seepage waters are included in the analysis of streamflows under the operation of the Proposed Action.

1.6.2.1.1 Transbasin Diversion. The water supply for the Proposed Action would be a transbasin diversion from Strawberry Reservoir averaging approximately 163,400 acre-feet per year, including 101,900 acre-feet of SFN System water and 61,500 acre-feet of SVP water from Strawberry Reservoir.

The Syar Tunnel and Sixth Water Aqueduct would release about 146,000 acre-feet of Strawberry Reservoir water per year. The maximum flow rate of Syar Tunnel would range from 660 cfs when Strawberry Reservoir is full to 617 cfs when the water level in the reservoir is at its operational minimum.



Map 1-2
Agricultural Lands Served by the SFN System



Map 1-3
"Diamond Fork Tunnel Alternative" Under the Proposed Action and MCAPW-DFT Alternative

Table 1-6
Summary of Project Features Resulting from the Proposed Action and Alternatives

Project Feature	Proposed Action	Alternative					
		MCAPW-DFT	MCAP	MCAPW	MCATC	MCAT	No Action
"Diamond Fork Tunnel Alternative"							
Length of Tanner Ridge Tunnel (feet)	4,700	4,700	NA	NA	NA	NA	NA
Length of Diamond Fork Siphon (feet)	7,800	7,800	NA	NA	NA	NA	NA
Length of Red Mountain Tunnel Extension (feet)	9,000	9,000	NA	NA	NA	NA	NA
Length of Red Hollow Pipeline (feet)	10,400	10,400	NA	NA	NA	NA	NA
Number of Construction Staging Areas	6	6	NA	NA	NA	NA	NA
Diamond Fork Dams and Reservoirs							
Capacity of Reservoir (acre-feet)	NA	NA	33,100	33,100	33,100	33,100	430
Length of Diamond Fork Pipeline Extension (feet)	NA	NA	500	500	500	500	13,200
Main Conveyance Aqueduct and Associated Features							
Number of Pipeline Segments	8	8	8	8	10	10	NA
Total Pipeline Length (miles)	43.6	43.5	43.6	43.5	40.1	40.1	NA
Length of Distribution Pipelines at Turnouts EJ1 to EJ4 (miles)	2.1	2.1	2.1	2.1	2.1	2.1	NA
Number of Tunnels	0	0	0	0	3	3	NA
Number of Turnouts	20	20	21	21	21	20	NA
Number of Regulating Ponds	4	4	4	4	4	4	NA
Capacity of Main Conveyance Reservoir (acre-feet)	300	300	300	300	300	300	NA
Number of Equalization Reservoirs	2	2	2	2	2	2	NA
Number of Construction Staging Areas	8	8	8	8	8	8	NA
Length of Recreation Trail (miles)	14.3	NA	14.3	NA	NA	NA	NA

Strawberry Tunnel would release about 17,400 acre-feet (plus 3,600 acre-feet of tunnel seepage) per year. Releases of Strawberry Reservoir water from the Strawberry Tunnel would be primarily for streamflow maintenance in Sixth Water Creek. However, the Strawberry Tunnel would infrequently (less than 1 percent of the time) be used to convey up to 125 cfs from Strawberry Reservoir to meet summer demands for SVP and Bonneville Unit irrigation water. The maximum rate of transbasin diversion from both Syar and Strawberry Tunnels would be 785 cfs under the Proposed Action.

The water released by Strawberry Tunnel would be combined with the natural flow of Diamond Fork Creek (20,900 acre-feet) and water released to the creek from the features of the "Diamond Fork Tunnel Alternative" to maintain required minimum flows from below Monks Hollow to the Spanish Fork River. The operation of the Diamond Fork System is shown in Figure 1-3.

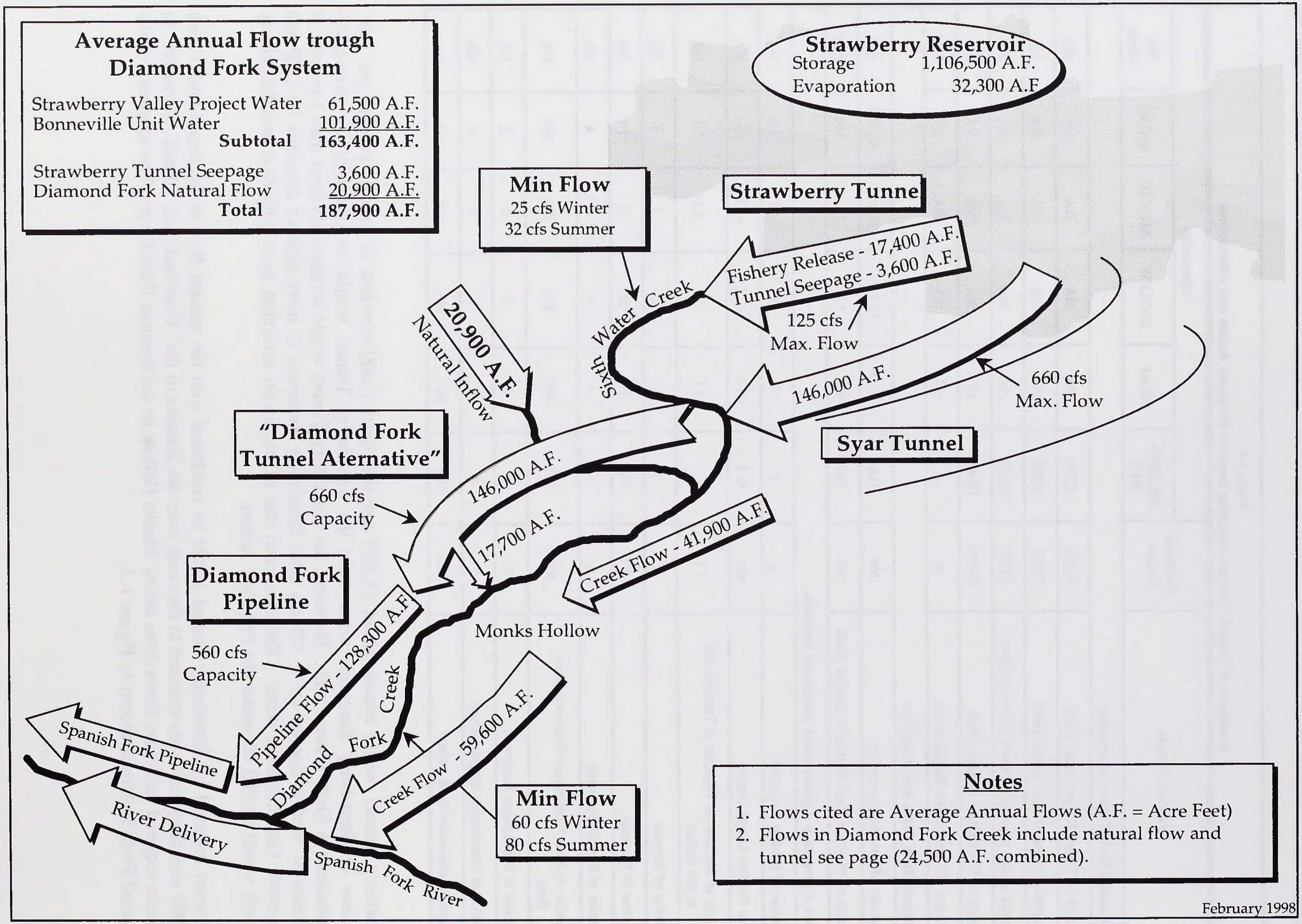


Figure 1-3
Schematic of Diamond Fork System Operation Under the Proposed Action

There would be three components of discharge from Strawberry Tunnel.

- **Sixth Water Creek Instream Flows.** Releases would be made from Strawberry Reservoir in the amounts necessary to attain the minimum flow rates in Sixth Water Creek that are specified in Section 303(c) of CUPCA, subject to adjustment for greater enhancement of aquatic and riparian habitat along the creek. CUPCA specifies minimum flows of 32 cfs from May through October and 25 cfs from November through April in Sixth Water Creek between the outlet of Strawberry Tunnel and the outlet of the Sixth Water Aqueduct, a creek distance of approximately 6 miles.

- **Infrequent Irrigation Water Releases.** Additional releases, up to a total of approximately 125 cfs, would be made during infrequent years when the summer irrigation demand exceeds the capacity of Syar Tunnel. In the 44-year operations study, the use of Strawberry Tunnel for this purpose occurred in only 5 months, with the largest release rate being 125 cfs.

- **Emergency Use.** Releases up to the maximum capacity of Strawberry Tunnel if Syar Tunnel or Sixth Water Aqueduct is rendered unusable, or emergency circumstances require the use of Strawberry Tunnel to deliver contracted Bonneville Unit water and SVP water, as stipulated in Section 303(f) of CUPCA. The tunnel is capable of delivering up to 200 cfs.

In addition to the transbasin diversions, water from three other sources would be involved in the operation of the Proposed Action. The first source is the current Strawberry Tunnel discharge of 3,600 acre-feet of water that seeps into the tunnel annually. The second source is water from the natural flow of Diamond Fork Creek, which averages 20,900 acre-feet per year at Monks Hollow. Water from these two sources is involved in the operation of the Diamond Fork System and Diamond Fork Creek. The third source is the natural flow of the Spanish Fork River, which, together with the flow of Diamond Fork Creek, influences aquatic conditions in the Spanish Fork River. Water from these three sources is not Bonneville Unit water.

The transbasin diversions through Strawberry and Syar Tunnels would continue year-round except for shutdowns required for maintenance. During the non-irrigation season, the continuous release from Strawberry Tunnel would maintain the minimum flows except as described below. The winter releases through Syar Tunnel would maintain a continuous flow of water through the features of the "Diamond Fork Tunnel Alternative," part of which would be released to lower Diamond Fork Creek for flow maintenance. The releases to lower Diamond Fork Creek would be made at the point where Red Hollow Pipeline would connect to the Diamond Fork Pipeline. That point would be located about 2,500 feet downstream of the confluence of Monks Hollow and Diamond Fork Creek, as shown on Map 1-3. The rest of the water would continue through the Diamond Fork Pipeline and Main Conveyance Aqueduct, except in months when delivery to Mona Reservoir has been completed and delivery to Utah Lake can be satisfied by the minimum flows in Diamond Fork Creek.

The flows described above would be subject to the following maintenance interruptions. Every year, the releases from Strawberry Reservoir through Strawberry and Syar Tunnels would be stopped for about a week by closing the inlet valves to Syar Tunnel. (Strawberry Tunnel receives its water from the inlet to Syar Tunnel.) During this shutdown, the tunnels, the features of the "Diamond Fork Tunnel Alternative," and Main Conveyance Aqueduct would be dewatered and the tunnels, pipelines, and valves inspected. The shutdown would be scheduled when the water deliveries to Utah Lake are at a minimum for the year. In addition to the week-long annual shutdown, a 3-week maintenance shutdown of Syar and Strawberry Tunnels may potentially be needed at an estimated recurrence interval of once every 7 to 10 years (CUWCD 1997f).

1.6.2.1.2 Return Flows. The Bonneville Unit water from Strawberry Reservoir used in southern Utah and eastern Juab Counties would produce 25,500 acre-feet of reusable return flows. Of this amount, 4,700 acre-feet would be reused for crop irrigation and 20,800 acre-feet would flow to Utah Lake for exchange with Jordanelle Reservoir. The return flows would be Bonneville Unit water.

1.6.2.1.3 Water Delivery. Under the Proposed Action, the 101,900 acre-feet of Bonneville Unit water released from Strawberry Reservoir would be conveyed to southern Utah and eastern Juab Counties for irrigation, M&I use, and water supply for Utah Lake. The distribution of the 101,900 acre-feet is shown in Table 1-7. The Bonneville Unit irrigation water would be used on the southern Utah and eastern Juab County lands shown on Map 1-2; the M&I water would be used in southern Utah County; and the Utah Lake water supply would be used for exchange to Jordanelle Reservoir.

Table 1-7
Bonneville Unit and SVP Average Water Deliveries Under the Proposed Action and MCAPW-DFT Alternative
(acre-feet/year)

Purpose	Transbasin Diversion from Strawberry Reservoir (Bonneville Unit and SVP Water)	Bonneville Unit Return Flows Available for Reuse	Total
Bonneville Unit Water Supply			
Irrigation Water			
Spanish Fork area	21,700	0	21,700
Santaquin area	6,000	0	6,000
Elberta area	0	3,400[a]	3,400
Mona area	13,700	0	13,700
West Mona area	4,400	1,300[b]	5,700
Nephi area	22,600	0	22,600
Subtotal	**68,400**	**4,700**	**73,100**
M&I Water for Southern Utah County[b]	11,200	0	11,200
Utah Lake Water Supply	22,300	20,800	43,100
Total, Bonneville Unit	**101,900**	**25,500**	**127,400**
SVP Water Supply			
Irrigation water, Spanish Fork area	61,500	0	61,500
Total Delivery	**163,400**	**25,500**	**188,900**

[a]Deliveries of return flow from Mona Reservoir.
[b]Delivered to Utah Lake in exchange for groundwater pumping in southern Utah County.

The 25,500 acre-feet of useable return flow cited in the preceding section would be used to increase the irrigation water and Utah Lake water supplies. With the return flows, Bonneville Unit irrigation water would total 73,100 acre-feet, and water delivery to Utah Lake would total 43,100 acre-feet. The amount of M&I water provided would be 11,200 acre-feet per year and would involve a groundwater exchange as explained later in this section.

In addition to Bonneville Unit water, the Proposed Action would convey 61,500 acre-feet of SVP water from Strawberry Reservoir to southern Utah County for use by farms in the Spanish Fork area.

In addition, the Bonneville Unit water released from Strawberry Reservoir would include 11,200 acre-feet for M&I use involving a groundwater exchange as described below and 22,300 acre-feet for delivery to Utah Lake for exchange to Jordanelle Reservoir and to allow instream flow requirements in Diamond Fork Creek to be met. Natural streamflow is not included in Table 1-7.

Approximately 79 percent of the combined annual Bonneville Unit and SVP water from Strawberry Reservoir would be conveyed in the Diamond Fork Pipeline and the Main Conveyance Aqueduct for delivery in Utah and Juab Valleys. The remaining water would be released to Diamond Fork Creek for delivery to diverters from the Spanish Fork River, for streamflow maintenance, and for delivery to Utah Lake.

Minimum streamflows in lower Diamond Fork Creek would receive first priority for routing the water and would govern the release of water to the creek near Monks Hollow. Flow in Diamond Fork Creek would be maintained at 80 cfs from May through September and 60 cfs from October through April.

These flows are based on a preliminary assessment of flow rates needed to maintain aquatic and riparian habitat. The Mitigation Commission is planning to investigate the flow rates needed for various components of the aquatic and riparian habitat and will evaluate the use of lower minimum flows in conjunction with occasional higher releases to provide greater benefits to selected aquatic and riparian resource components (i.e., providing flushing flows to help regenerate riparian plant communities). If the Mitigation Commission concludes that seasonal minimum flows of less than the stipulated 80 cfs and 60 cfs would be more suitable most of the time, the amount of water equivalent to the difference between the new recommended flows and the 80 cfs or 60 cfs rates would be left in Strawberry Reservoir for use at other times in the same year. The retained water would be available for release when higher flows of short duration are desired for habitat management, including brief flushing flows and channel maintenance flows for fish or riparian vegetation. Operation with lower minimum flows would require additional NEPA compliance and Congressional action to recognize the changes from the flow provisions of CUPCA.

The rest of the water needed for irrigation demand or other purposes would flow through the Diamond Fork Pipeline until the pipeline is operating at its maximum capacity of 560 cfs. Any further increase in flow needed for downstream delivery would be released to Diamond Fork Creek at Monks Hollow and conveyed to the Spanish Fork River for diversion at the Strawberry Diversion Dam.

The water diverted by the Strawberry Diversion Dam would serve both the Salem distribution pipeline (see Section 1.9) and SVP power plants during the summer and only the power plants during the winter when no irrigation occurs. The Salem distribution system begins at the terminus of the SVP Power Canal and delivers water to lands served by the High Line, South Field, and Salem Canals. Flows passing the Strawberry Diversion Dam would continue downriver to irrigation companies that divert water directly from the Spanish Fork River.

The Main Conveyance Aqueduct, from its beginning to Turnout SU7, would contain the following categories of water:

- SVP water for irrigation, consisting of 83 percent of the total SVP water from Strawberry Reservoir and some natural streamflow of Diamond Fork Creek
- Bonneville Unit irrigation water, amounting to 91 percent of the total Bonneville Unit irrigation water from Strawberry Reservoir
- Bonneville Unit M&I water, which would be released to the Spanish Fork River and then conveyed to Utah Lake for exchange with groundwater (as much of the M&I water as capacity in the aqueduct permits)
- Utah Lake water supply for exchange with Jordanelle Reservoir, which would be released to the Spanish Fork River and conveyed to Utah Lake (a portion of this water would be conveyed in the Main Conveyance Aqueduct, depending on aqueduct capacity available).

Turnout SU1, located downstream of the Strawberry Diversion Dam (for locations of turnouts, see Map 1-4) would deliver water from the Main Conveyance Aqueduct into the Mapleton Lateral, into the SVP Power Canal for

delivery to the Salem distribution pipeline, and for release back to the Spanish Fork River for diversion by irrigation companies further downstream. Turnout SU1 would also release water to the Spanish Fork River for delivery to Utah Lake.

Beyond Turnout SU1, the Main Conveyance Aqueduct would convey irrigation water for delivery to local distribution systems from Spanish Fork to Nephi. Figure 1-4 shows a schematic of the distribution process.

At Turnouts SU3, SU4, SU5, and SU6, irrigation water would be released. At Turnouts SU3 and SU4, 1,400 acre-feet and 800 acre-feet, respectively, would be released to the irrigated areas adjacent to the High Line Canal in the Spanish Fork area. At Turnout SU5, 11,900 acre-feet would be released into the distribution system known as Lateral 20. At Turnout SU6, 29,300 acre-feet would be released to serve High Line Canal Laterals 30 to 34 and the South Shore area of Utah County.

In the Summit Creek Irrigation Company service area, water from Turnout SU7 would be delivered to a regulating pond where flows from Summit Creek and the SFN System would be combined. In addition, the Summit Creek Irrigation Company could lease its three wells to the CUWCD. These wells would be pumped during the peak summer months, allowing the conjunctive use of surface and groundwater to meet the needs of the area.

The 3,400 acre-feet per year of supplemental irrigation water for the Elberta area would be supplied by Bonneville Unit return flows captured in Mona Reservoir. The water would be released from Mona Reservoir to Currant Creek and then diverted into the locally owned Currant Creek Pipeline for delivery to the Elberta area.

Bonneville Unit water deliveries in eastern Juab County would be made as follows. In the Mona area, Turnouts EJ1 to EJ6 would release water to local distribution systems operated by various water companies including the North Canyon subarea. Water for the west Mona area, except for return flows collected in Mona Reservoir, would be released at Turnout EJ5 and conveyed to the southern end of the reservoir by local water distribution facilities under an operating agreement. Releases for the Nephi area would be delivered through Turnouts EJ7 to EJ14, which would release water to local distribution systems operated by various water companies including the East Juab Water Efficiency Project (EJWEP). The Bonneville Unit water would supplement the existing supplies from local surface and groundwater sources. Ultimately, the East Juab Water Conservancy District plans to divert Salt Creek water into the Main Conveyance Aqueduct on a coordinated-operation basis for delivery with Bonneville Unit water, as described later in Section 1.9, this chapter under Related Actions (Local Development).

The area west of Mona Reservoir would receive an annual water supply of about 5,700 acre-feet, which would be pumped from Mona Reservoir. About 4,400 acre-feet per year would be Strawberry Reservoir water released from the Main Conveyance Aqueduct to Mona Reservoir through distribution systems in the Mona area. A portion of this water could remain in the Main Conveyance Aqueduct and be released to West Creek in the area west of Nephi. The remaining 1,300 acre-feet would be provided from return flows of Bonneville Unit irrigation water collected in Mona Reservoir.

The return flows to Mona Reservoir would increase by 11,900 acre-feet per year as a result of the additional irrigation water supply in eastern Juab County. After 200 acre-feet of evaporation losses from Mona Reservoir, the usable amount of return flow would be 11,700 acre-feet, which would be distributed to the Elberta area (3,400 acre-feet), the west Mona area (1,300 acre-feet), and Utah Lake (7,000 acre-feet).

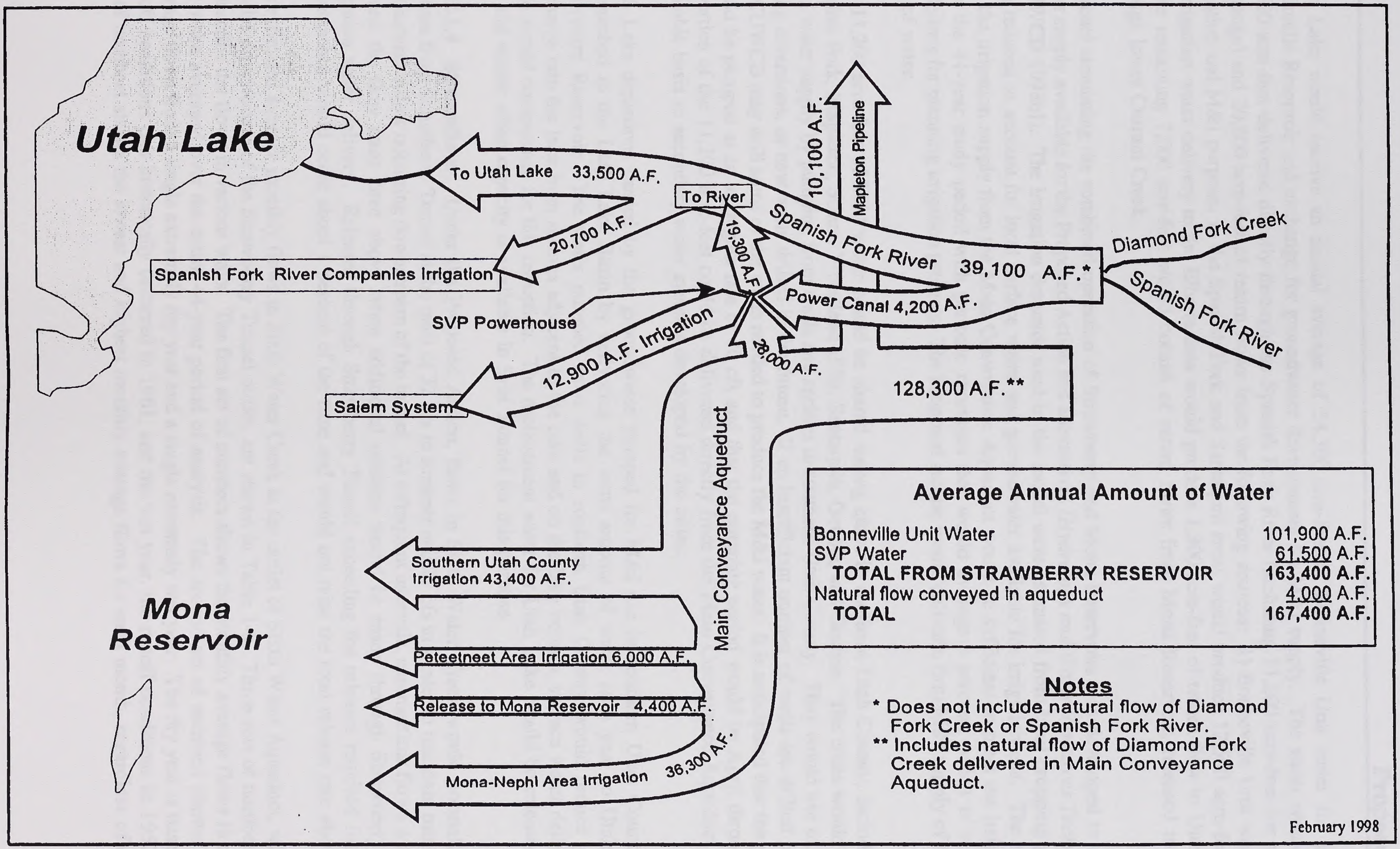


Figure 1-4
Schematic Representation of Proposed Action Operation

Utah Lake would receive an annual average of 54,300 acre-feet of Bonneville Unit water for exchange to Jordanelle Reservoir and exchange for groundwater development for M&I supply. The water would consist of 33,500 acre-feet delivered directly through the Spanish Fork River (including 11,200 acre-feet for groundwater exchange) and 20,800 acre-feet of return flows from the following sources: 1) Bonneville Unit water used for irrigation and M&I purposes in the Spanish Fork and Santaquin areas would produce 12,500 acre-feet annually; 2) irrigation water delivery to the Elberta area would produce 1,300 acre-feet of return flow to Utah Lake; and 3) the remaining 7,000 acre-feet would consist of return flows from Mona Reservoir, released to Utah Lake through lower Currant Creek.

A model simulating the combined operation of Strawberry and Mona Reservoirs was developed to estimate the water supply available for the Proposed Action and alternatives (*Hydrology and Water Resources Technical Report* [CUWCD 1998b]). The irrigation demands used in the model were estimated from local cropping patterns and then reduced to account for local surface water and groundwater available for irrigation use. The results show that the irrigation supply from the Main Conveyance Aqueduct would be sufficient to meet the irrigation needs over the 44-year study period with periodic shortages that would average 5 percent, which is within USBR guidelines for planning irrigation projects. The Proposed Action would deliver a firm M&I supply of 11,200 acre-feet of water.

The 11,200 acre-feet of M&I water would be shared among cities in southern Utah County, including Payson, Spanish Fork, Mapleton, Salem, Woodland Hills, Santaquin, Genola, and Goshen. The cities would develop the M&I water supply by pumping from wells and springs in southern Utah County. They would use existing wells, spring diversions, or new wells drilled in the future. If an insufficient number of wells are drilled in the future, the CUWCD may drill some of the wells needed to produce the M&I water. It is anticipated that the groundwater would be pumped at an aggregate rate of 40 cfs and that the pumping period would be April through October. A portion of the 11,200 acre-feet could be delivered directly from the Main Conveyance Aqueduct on a space-available basis to secondary water systems developed by the cities.

Utah Lake depletions caused by the groundwater pumped for M&I use in southern Utah County would be replenished to the Utah Lake Basin by delivering the same amount of water each year to Utah Lake from Strawberry Reservoir. The water pumped from wells in southern Utah County would reduce groundwater discharge into the lake from springs adjacent to the lake and on the lake bottom; surface water delivery to Utah Lake would compensate for this reduction. The replacement water for Utah Lake would be released during the fall and winter when capacity is available in Syar Tunnel for this purpose.

1.6.2.1.4 Streamflows. Under the Proposed Action, flows in Sixth Water Creek would normally consist of releases from Strawberry Tunnel at the rates of 32 cfs in summer and 25 cfs in winter to maintain minimum flows, plus natural inflow occurring downstream of the tunnel. At infrequent intervals, summertime flows would increase beyond the flow rates cited above when additional releases would be made through Strawberry Tunnel for irrigation water delivery. Releases through Strawberry Tunnel exceeding the releases required for streamflow maintenance would occur about 1 percent of the time and would not raise the total release rate above 125 cfs.

The estimated average monthly flows in Sixth Water Creek at the outlet of Sixth Water Aqueduct, which is about 6 miles downstream of the Strawberry Tunnel outlet, are shown in Table 1-8. Three sets of numbers are shown to describe the flows in various ways. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-8
Streamflows in Sixth Water Creek at Sixth Water Aqueduct Resulting from the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	27	27	27	28	34	49	43	36	34	34
acre-feet	2,100	1,630	1,660	1,650	1,520	1,710	2,040	2,990	2,590	2,200	2,080	2,020
Representative dry year and wet year monthly average flows (cfs)												
Dry year[b]	34	27	27	27	27	27	28	36	32	32	33	34
Wet Year[c]	35	28	28	27	29	28	59	88	53	37	36	35
Lowest and highest monthly average flows (cfs)												
Lowest[d]	32	26	25	26	26	26	26	33	32	32	32	32
Highest[d]	36	30	30	28	29	31	59	88	131	74	38	38

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Springs and seeps add water to Sixth Water Creek downstream from the Sixth Water Aqueduct, and Fifth Water Creek discharges an annual average flow of 7 cfs into Sixth Water Creek. Consequently, the flow in the last mile of Sixth Water Creek would average about 8 cfs greater than the flows shown in Table 1-8.

Flows in Diamond Fork Creek below Monks Hollow under the Proposed Action would consist of natural flow of Diamond Fork Creek, releases from Strawberry Tunnel to maintain flows in Sixth Water Creek, and releases from the proposed turnout approximately 2,500 feet downstream of the confluence of Monks Hollow and Diamond Fork Creek, as shown on Map 1-3. The releases to Diamond Fork Creek at Monks Hollow would maintain minimum flows of 60 or 80 cfs, depending on the season. Additional releases would be made to the creek when needed to meet peak period irrigation water demand.

The projected flows in Diamond Fork Creek at a point approximately 2,500 feet downstream of Monks Hollow under the Proposed Action are shown in Table 1-9. The flows would consist of releases from Strawberry Tunnel to maintain minimum flows and very infrequently to provide additional irrigation water, natural flow in Diamond Fork Creek, and releases from the proposed turnout below Monks Hollow. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest minimum and maximum monthly average flows for each month, regardless of the year.

Table 1-9
Streamflows in Diamond Fork Creek Below Monks Hollow Resulting from the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	60	60	60	60	60	60	60	81	130	194	81	80
acre-feet	3,690	3,570	3,690	3,690	3,330	3,690	5,240	8,850	7,620	6,520	4,920	4,760
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	60	60	60	60	60	60	60	80	80	80	80	80
Wet Year[c]	60	60	60	60	60	60	244	395	168	80	80	80
Lowest and highest monthly average flows (cfs)												
Lowest[d]	60	60	60	60	60	60	60	80	80	80	80	80
Highest[d]	60	60	60	60	60	60	244	395	267	174	80	80

[a]Flows over 80 cfs are rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

The Mitigation Commission, under Title III of CUPCA, is authorized to perform stream channel restoration work along Diamond Fork and Sixth Water Creeks. Additional studies to determine optimal seasonal flows will be conducted by the Mitigation Commission in cooperation with the U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, and the CUWCD. At certain times of the year, there would be unused capacity in the Diamond Fork Pipeline. More (or less) flow could be released to Diamond Fork Creek at certain times to provide operational flexibility that would be consistent with the Mitigation Commission's findings. Additional NEPA compliance documentation would be required if the Mitigation Commission proposes to vary the operation of Diamond Fork Creek significantly from that described above or reduce minimum flows below those specified in CUPCA.

The flow in the upper Spanish Fork River consists of the natural flow of the river plus the discharge of Diamond Fork Creek. The upper Spanish Fork River is defined as the section of river from the confluence of Diamond Fork Creek and the Spanish Fork River to the SVP Strawberry Diversion Dam near the mouth of the Spanish Fork Canyon. The projected flows in the upper Spanish Fork River under the Proposed Action are shown in Table 1-10. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-10
Streamflows in the Upper Spanish Fork River Resulting from the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	114	113	114	114	128	154	267	427	262	176	155	138
acre-feet	7,030	6,750	7,020	7,030	7,100	9,500	15,910	26,270	15,560	10,810	9,530	8,230
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	93	94	91	93	99	107	100	119	100	103	116	115
Wet Year[c]	112	108	108	120	128	149	1,079	1,895	570	269	218	188
Lowest and highest monthly average flows (cfs)												
Lowest[d]	88	90	90	93	91	99	100	119	100	103	100	105
Highest[d]	162	159	162	172	179	249	1,079	1,895	570	269	438	305

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.2.1.5 Operating Entity. The CUWCD would operate and maintain the facilities of the Proposed Action under operating agreements with the federal government and a number of local water districts, water companies, and cities that would address operational aspects of the SFN System. SVP water would be conveyed in the Diamond Fork System and the Main Conveyance Aqueduct under a 1998 operating contract with SWUA. Other matters addressed by agreements would include the sale and delivery of Bonneville Unit irrigation and M&I water (including repayment of delivery costs), conveyance of water for fishery enhancement in Bonneville Unit facilities, storage of Bonneville Unit water in Mona Reservoir, and the conveyance of Salt Creek water in the Nephi Pipeline segment of the Main Conveyance Aqueduct. The agreements are described in Section 1.7.

1.6.2.1.6 Projected Operational Life. The standard operational life of the major Proposed Action features are shown in Table 1-11. The typical operational life of projects of this type is at least 75 years before major rehabilitation work would be required. These features would be replaced as they wear out. Rehabilitation and ongoing maintenance would indefinitely prolong the operational life of the Proposed Action.

Table 1-11
Standard Operational Life of Proposed Action Features

Facility	Standard Life (years)
Pipeline	75
Turnouts	15 - 25
Regulating Ponds	75
Equalization Reservoirs	75
Main Conveyance Reservoir	75
Power Line	25
Pumping Plant	15 - 25
Permanent Access Roads	35
Recreation Trail	35

1.6.2.1.7 Automated Control System. A Supervisory Control and Data Acquisition System (SCADA) would be installed to control and monitor the operation of the Proposed Action from an operations center at CUWCD Headquarters. The SCADA system would consist of remote telemetry units (RTUs) linked to one or more personal computers at the operations center. The RTUs would be located at the inlet to Syar Tunnel, the outlet of Sixth Water Aqueduct, the end of the Red Hollow Pipeline, the turnout to Diamond Fork Creek, and other key locations on the Main Conveyance Aqueduct. The RTUs would be connected to instruments or sensors to monitor pressure, flow, valve position, and other parameters and would allow the remote control of valves at turnouts. The control system would contain an alarm system with the capability to notify key personnel when emergency situations occur and would also store operational data for accounting purposes. Remote sensor units would be located on previously disturbed lands in the Diamond Fork drainage and would be linked by satellite.

1.6.2.1.8 Coordination with Local Water Supplies. The Proposed Action would coordinate delivery of Bonneville Unit water with local water supplies in several ways. SVP water would be conveyed in the "Diamond Fork Tunnel Alternative" and part of the Main Conveyance Aqueduct, and Salt Creek water (non-Bonneville Unit water) would be conveyed in certain reaches of the Main Conveyance Aqueduct. Main Conveyance Aqueduct turnouts would release water to existing local water distribution systems. At four turnouts, regulating ponds would be built to allow aqueduct water to be mixed with water diverted from local streams before release to local distribution systems. In addition, the operation of existing irrigation wells would be rescheduled to help meet peak summer irrigation water needs under a voluntary pumping program. These coordination measures would facilitate the most efficient operation attainable with the combined waters from Strawberry Reservoir, local creeks, and existing irrigation wells.

The irrigation wells whose operation would be rescheduled are located in southern Utah and eastern Juab Counties. At present, many irrigators rely on groundwater to continue irrigation when the flow of local creeks decrease in the late summer and fall. Under the Proposed Action, the new supply of Bonneville Unit water would eliminate dependence on groundwater for late season irrigation, permitting a shift in groundwater pumping to mid-summer. Historically, maximum groundwater use has been in August. Shifting the peak groundwater use to July (the peak water use month) would enable irrigation wells to contribute more effectively to peak period irrigation water needs. The use of wells in this manner reduces the maximum flow capacity needed in the Main Conveyance Aqueduct. The average annual volume of groundwater pumping within southern Utah and eastern Juab Counties would remain the same.

An estimated 18 wells would be involved in the coordinated pumping program, under voluntary operating agreements with their owners. If an insufficient number of existing wells are available for inclusion in this program, the CUWCD may drill some wells of its own to enable the program to operate as planned. Water from participating wells would, depending on locations, be pumped into local irrigation systems or used on the farms where they are located. In either case, they would reduce the amount of water needed for delivery during the peak irrigation demand period.

The State Engineer's policy with regard to groundwater development, as documented in *Utah/Goshen Valley Groundwater Management Plan* (Utah Department of Natural Resources 1995b) and *Northern Juab Valley Groundwater Policy* (Utah Department of Natural Resources 1995a), restricts the appropriation of additional groundwater in these areas and states that new groundwater production needs to be based on acquiring and transferring existing groundwater or surface water rights. The Proposed Action is consistent with this policy in that there would be no net depletion of groundwater discharges to Utah Lake.

1.6.2.1.9 Power Requirements. Under the Proposed Action, CRSP power would be used to meet the power requirements of the SFN System. Approximately 6,927,000 kilowatt-hours of energy per year would be required to operate the pumping plants and wells, after a credit for increased generation at SVP power plants. These power requirements are summarized in Table 1-12.

Table 1-12 Proposed Action Average Annual Power Requirements		
Purpose/Location	**Peak Capacity (kilowatts)**	**Average Annual Energy (kWh)**
Replacement Power		
Spanish Fork Power Plants	1,880	-1,693,000
Pumping Power		
West Mona Pumping Plant	900	2,500,000
M&I Wells	1,700	6,120,000
Total Power	**4,900**	**6,927,000**

1.6.2.2 "Diamond Fork Tunnel Alternative"

Under the Proposed Action, the "Diamond Fork Tunnel Alternative" (two tunnels, a siphon, and a pipeline) would be constructed to connect the Sixth Water Aqueduct to the Diamond Fork Pipeline. A turnout would be built at Monks Hollow to release water to Diamond Fork Creek. The "Diamond Fork Tunnel Alternative" would be constructed in lieu of constructing Monks Hollow Dam and Reservoir to complete the Diamond Fork System. The following sections discuss the various segments of the "Diamond Fork Tunnel Alternative" (see Map 1-3).

1.6.2.2.1 Tanner Ridge Tunnel. The Tanner Ridge Tunnel would convey water through Tanner Ridge, which lies between Sixth Water Creek Canyon and upper Diamond Fork Creek Canyon. The 660 cfs tunnel would be 4,700 feet long and have a diameter of 114 inches. The inlet portal of the tunnel would be at the same elevation as the outlet of Sixth Water Aqueduct, which is essentially at the bottom of Sixth Water Canyon.

The Tanner Ridge Tunnel would be connected to the outlet of Sixth Water Aqueduct by the tunnel inlet structure consisting of a connecting pipeline under Sixth Water Creek. The connecting pipeline would convey water from the existing valve structure at the end of the Sixth Water Aqueduct to the inlet portal of the Tanner Ridge Tunnel on the opposite side of Sixth Water Canyon. The 660 cfs connecting pipeline would be 500 feet long and have a diameter of 96 inches. The inlet structure would be designed to facilitate the development of a hydropower generating plant at the outlet of Sixth Water Aqueduct, which is a future possibility with non-federal funding. The outlet portal of Tanner Ridge Tunnel would be near Diamond Fork Creek, about 2.3 miles upstream of Three Forks, and would be set back approximately 2,000 feet horizontally from the creek. The outlet portal would be about 400 feet higher than the floor of the canyon.

1.6.2.2.2 Diamond Fork Siphon. The Diamond Fork Siphon would cross under upper Diamond Fork Creek, forming the connection between the outlet of the Tanner Ridge Tunnel and the inlet of Red Mountain Tunnel. The 660 cfs pipeline would be approximately 7,800 feet long and have a diameter of 96 inches. From the outlet of Tanner Ridge Tunnel, the pipeline would descend to the floor of Diamond Fork Canyon, run in a downstream direction along the bottom of the canyon for about 2,300 feet, and then ascend the west side of upper Diamond Fork Canyon to the inlet of Red Mountain Tunnel. Along the bottom of Diamond Fork Canyon, the pipeline would be constructed outside of the riparian zone except where it crosses under the creek. Rights-of-way required for the pipeline would be a permanent 50-foot width plus a temporary 100-foot width.

1.6.2.2.3 Red Mountain Tunnel. Red Mountain Tunnel would convey water through Red Mountain from Diamond Fork Siphon to Red Hollow. The 660 cfs tunnel would be approximately 9,000 feet long and have a diameter of 114 inches. The tunnel inlet would be about 400 feet higher than the floor of Diamond Fork Canyon. The tunnel outlet would be several hundred feet above the bottom of Red Hollow.

1.6.2.2.4 Red Hollow Pipeline. The 660 cfs Red Hollow Pipeline would begin at the end of Red Mountain Tunnel and end at the beginning of the Diamond Fork Pipeline. It would be approximately 10,400 feet long and have a diameter of 96 inches. From the outlet of Red Mountain Tunnel, the pipeline alignment would descend into Red Hollow, cross under the creek bed, and ascend the opposite (west) side of Red Hollow. The location of the creek bed crossing would be selected to minimize disturbance of phreatophytic vegetation at the edge of the creek channel. The pipeline would leave Red Hollow over a low saddle, then turn south and descend into Diamond Fork Canyon at the upstream end of the Diamond Fork Pipeline. Rights-of-way required for the pipeline would be a permanent 50-foot width plus a temporary 100-foot width.

A pressure-reducing station would be constructed at the end of the Red Hollow Pipeline, just before it connects with the Diamond Fork Pipeline. Its purpose would be to dissipate pressure buildup resulting from the elevation difference (about 900 feet) between the outlet of Red Mountain Tunnel and the end of the Red Hollow Pipeline.

1.6.2.2.5 Turnout near Monks Hollow. A turnout to Diamond Fork Creek would be constructed where the Red Hollow Pipeline would connect to the Diamond Fork Pipeline. The location of the turnout to Diamond Fork Creek would be about 2,500 feet downstream of the confluence of Monks Hollow and Diamond Fork Creek, as shown on Map 1-3. The turnout would release water from the Red Hollow Pipeline to the creek for flow maintenance and for irrigation water deliveries when needed.

1.6.2.3 Main Conveyance Aqueduct

As shown on Map 1-4, the alignment of the Main Conveyance Aqueduct has been divided into eight pipeline segments; these segments are listed in Table 1-13 and described in the following paragraphs. (The distance markers shown on Map 1-4 are linear distances from the beginning of the pipeline and are used as reference points throughout this document). The right-of-way easement widths for the Main Conveyance Aqueduct, which vary with terrain and proximity to highways, are provided in Table 1-14.

1.6.2.3.1 Spanish Fork Pipeline. The Spanish Fork Pipeline would begin at the end of the Diamond Fork Pipeline at distance marker 300 on the north side of Highway 6 at Diamond Fork Road. It would proceed west along the north side of Highway 6 for 3.8 miles, ending at distance marker 20,600, located north of the Strawberry Diversion Dam. The alignment of the Spanish Fork Pipeline segment within Spanish Fork Canyon is shown in detail on Map 1-5. The pipeline would be 108 inches in diameter and have a capacity of 560 cfs.

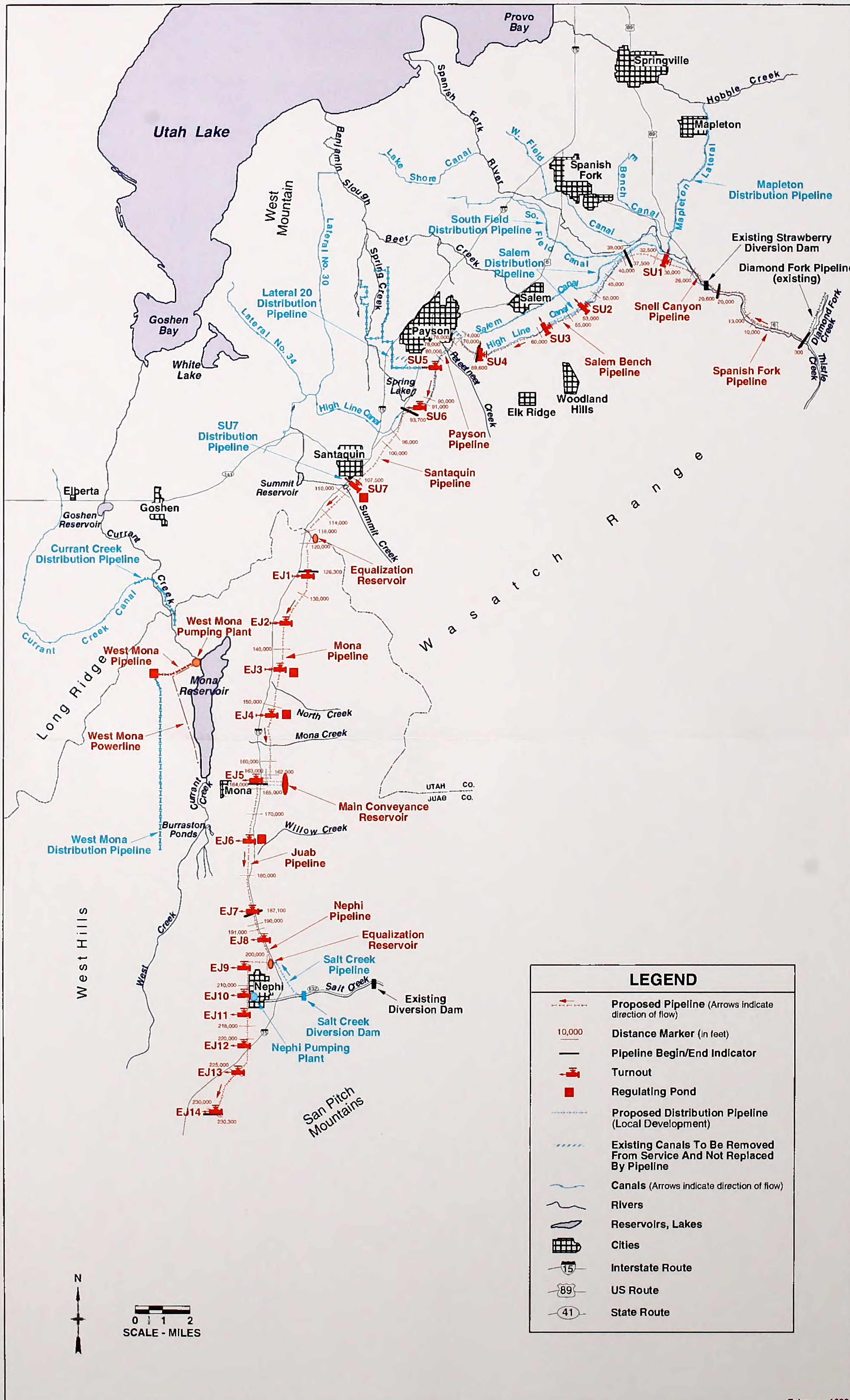
1.6.2.3.2 Snell Canyon Pipeline. The Snell Canyon Pipeline would begin at distance marker 20,600, north of the Strawberry Diversion Dam. It would parallel Highway 6 approximately 1 mile to distance marker 26,825, where it would turn south and cross under Highway 6, the Denver and Rio Grande Western Railroad, the Spanish Fork River, the SVP Power Canal settling pond, and the SVP Power Canal. At this point, the pipeline would ascend about 280 feet to the bench above the SVP Power Canal and continue in a westerly direction, joining the High Line Canal at distance marker 39,000. This pipeline segment would be 3.5 miles long and range in capacity from 560 to 470 cfs.

1.6.2.3.3 Salem Bench Pipeline. The Salem Bench Pipeline would begin at distance marker 39,000 within the existing High Line Canal right-of-way. It would follow the High Line Canal right-of-way and end at distance marker 69,600. This pipeline segment would replace 5.8 miles of the High Line Canal and have a capacity of 470 cfs.

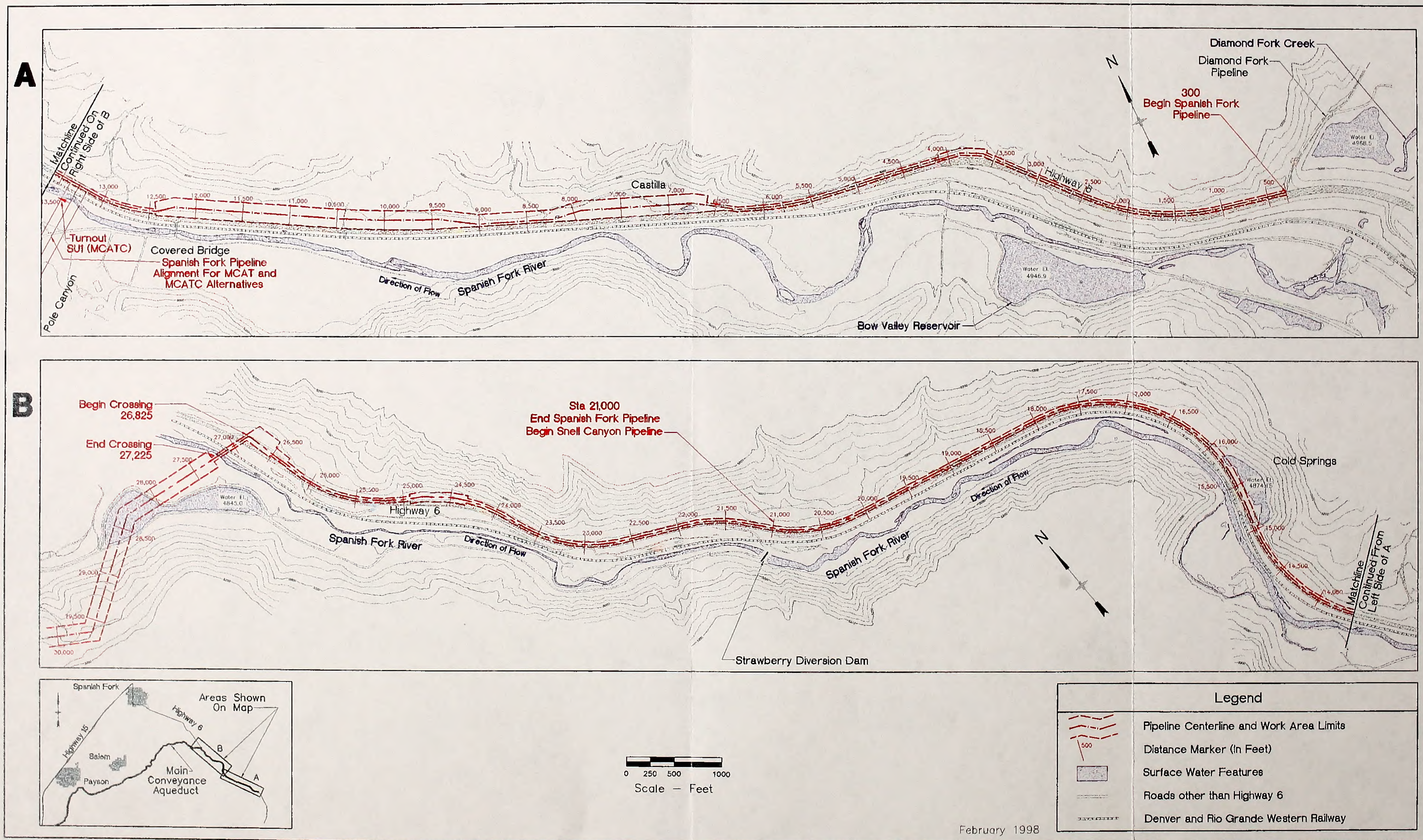
Table 1-13
Proposed Action Pipeline Segments

Segment Name	Distance Marker (feet)	Length (miles)	Diameter (inches)	Capacity (cfs)
"Diamond Fork Tunnel Alternative"				
Tanner Ridge Tunnel	NA	1.0	114	660
Diamond Fork Siphon	NA	1.5	96	660
Red Mountain Tunnel	NA	1.7	114	660
Red Hollow Pipeline	NA	1.9	96	660
Subtotal		**6.1**		
SFN System				
Spanish Fork Pipeline	300 to 20,600	3.8	108	560
Snell Canyon Pipeline	20,600 to 39,000	3.5	108	560 - 470
Salem Bench Pipeline[a]	39,000 to 69,600	5.8	108	470
Payson Pipeline[b]	69,600 to 93,700	4.6	108	470 - 390
Santaquin Pipeline	93,700 to 126,300	6.2	96 - 84	240 - 185
Mona Pipeline	126,300 to 164,000	7.1	84	180 - 150
Juab Pipeline	164,000 to 187,100	4.4	84	130 - 115
Nephi Pipeline	187,100 to 230,300	8.2	60 - 30	105 - 20
Subtotal (Main Conveyance Aqueduct Length)		**43.6**		
Distribution Pipelines at Turnouts EJ1 to EJ4[c]	NA	2.1	24 - 20	15 - 10
West Mona Pipeline	NA	1.4	33	25
Subtotal (SFN System)		**47.1**		
Total (Proposed Action)		**53.2**		

[a]The Salem Bench Pipeline would replace the High Line Canal for the entire length of the segment from distance marker 39,000 to 69,600.
[b]The Payson Pipeline would replace 4.5 miles of the High Line Canal between distance marker 69,600 and 93,700. An additional 0.1 mile of the High Line Canal would be removed from service, but would not be replaced with the pipeline because of the linear nature of the facility.
[c]Four distribution lines totaling 2.1 miles would be built with the Mona Pipeline to convey water from Turnouts EJ1 through EJ4 to the west side of I-15. These distribution lines would be between 0.4 and 0.6 mile in length.



Map 1-4
Main Conveyance Aqueduct Under the Proposed Action and MCAP Alternative



Map 1-5
Main Conveyance Aqueduct Alignment In Spanish Fork Canyon

Table 1-14
Main Conveyance Aqueduct Right-of-Way Easement Widths by Distance Marker for the Proposed Action

Distance Marker		Length (feet)	Width (feet)	
From	To		Temporary Easements*	Permanent Easements
300	3,600	3,300	0	50
3,600	4,100	500	0	75
4,100	6,400	2,300	0	50
6,400	6,600	200	0	72
6,600	6,740	140	85	100
6,740	7,920	1,180	100	100
7,920	8,220	300	65	100
8,220	9,030	810	25	100
9,030	9,430	400	65	100
9,430	12,230	2,800	100	100
12,230	12,430	200	70	100
12,430	15,030	2,600	0	50
15,030	16,000	970	0	75
16,000	24,330	8,330	0	50
24,330	24,930	600	0	100
24,930	26,330	1,400	0	50
26,330	26,520	190	0	100
26,520	26,810	290	100	100
26,810	27,270	460	0	50
27,270	200,000	172,730	100	100
200,000	230,300	30,300	60	60

*Temporary easement width is in addition to the permanent easement width. The temporary easement would be used only during construction. Distances showing no temporary easement are assumed to be within the existing Highway 6 right-of-way.

1.6.2.3.4 Payson Pipeline. The Payson Pipeline would begin at Turnout SU4 (distance marker 69,600) within the High Line Canal right-of-way. It would follow the High Line Canal right-of-way for 0.9 mile to distance marker 74,100 on the east side of Rock Ridge in Payson. At this point, the pipeline would diverge from the High Line Canal right-of-way and cross over the top of Rocky Ridge (a distance of 0.3 mile). The pipeline would rejoin the High Line Canal right-of-way at distance marker 75,800 and then continue along the High Line Canal for

3.4 miles to its end at Turnout SU6 (distance marker 93,700). The total length of the Payson Pipeline would be 4.6 miles. Its capacity would decrease from 470 cfs at Turnout SU4 to 390 cfs at Turnout SU6. The Payson Pipeline would replace approximately 5.6 miles of the High Line Canal, including 1.0 mile of canal alignment around the end of Rocky Ridge that would not be used for pipeline construction.

1.6.2.3.5 Santaquin Pipeline. The Santaquin Pipeline would begin within the High Line Canal right-of-way at distance marker 93,700. At this point, it would leave the High Line Canal right-of-way and run southeast of Highway 6 to Santaquin. It would then continue southeast of Interstate 15 (I-15) to distance marker 126,300. The Santaquin Pipeline would be 6.2 miles long, and its capacity would decrease from 240 cfs at Turnout SU6 to 185 cfs at Turnout EJ1.

1.6.2.3.6 Mona Pipeline. The Mona Pipeline would begin at distance marker 126,300 east of I-15. It would run south until it reaches the Mona interchange, where it would cross under I-15 and end at distance marker 164,000 at Turnout EJ5. The Mona Pipeline would be 7.1 miles long. Its capacity would decrease from 180 cfs at Turnout EJ1 to 150 cfs at Turnout EJ5. Four distribution lines at Turnouts EJ1 through EJ4 totaling 2.1 miles in length would be constructed with the Mona Pipeline (see footnote on Table 1-13). Each distribution line would be constructed from the turnout and would run west for 0.4 to 0.6 mile. Both the temporary and permanent easement widths of each distribution line would be 40 feet.

1.6.2.3.7 Juab Pipeline. The Juab Pipeline would begin at distance marker 164,000 west of the I-15 interchange at Mona. It would run south, paralleling I-15, to distance marker 187,100. The Juab Pipeline would be 4.4 miles long, and its capacity would decrease from 130 cfs at Turnout EJ5 to 115 cfs at Turnout EJ7.

1.6.2.3.8 Nephi Pipeline. The Nephi Pipeline would begin at distance marker 187,100 at Turnout EJ7 located on the west side of I-15. The pipeline would run south, paralleling I-15, to the edge of residential development at Nephi. At this point, the pipeline would turn west and proceed westward, crossing under the Union Pacific Railroad tracks and ending along 1500 North Street, approximately 400 feet west of the railroad tracks where it would connect to the Main Pipeline of the EJWEP, which is currently under construction. The EJWEP Main Pipeline alignment will extend 3 miles north/south, approximately 400 feet west of the railroad tracks; its southern end is at 1400 South Street in Nephi. At the end of the EJWEP Main Pipeline, construction of the SFN System's Nephi Pipeline would resume and continue south, crossing I-15 and ending at Turnout EJ14. The Nephi Pipeline would be 8.2 miles long, including the 3-mile length of the EJWEP Main Pipeline (5.2 miles of new construction). The Nephi Pipeline's capacity would decrease from 105 cfs at Turnout EJ7 to 20 cfs at Turnout EJ14.

The EJWEP is a local development project being constructed by the East Juab County Water Conservancy District (EJCWCD) and CUWCD, as described in Section 1.9.3.3.7. When connected to the Main Conveyance Aqueduct, the EJWEP Main Pipeline would be acquired by the CUWCD and incorporated into the Main Conveyance Aqueduct to avoid duplication of pipeline construction west of Nephi. The EJWEP Main Pipeline would be included in the SFN System under a transfer agreement with the DOI, as described in Section 1.7.

1.6.2.4 Turnouts and Regulating Ponds

1.6.2.4.1 Turnouts. Twenty turnouts would be constructed at various locations along the Main Conveyance Aqueduct to release water for local distribution (see Map 1-4). Each turnout would consist of a flow control valve installed inside a buried concrete vault and electronic instrumentation for controlling and monitoring turnout releases. A typical turnout is shown in Figure 1-5. Turnouts would discharge to local water distribution systems or into regulating ponds. The turnout capacities are shown in Table 1-15. The capacities listed provide for operational flexibility and the total of their capacities is consequently greater than the flow starting capacity of the Main Conveyance Aqueduct. Turnouts constructed as part of the EJWEP may take the place of Turnouts EJ9, EJ10, and EJ11.

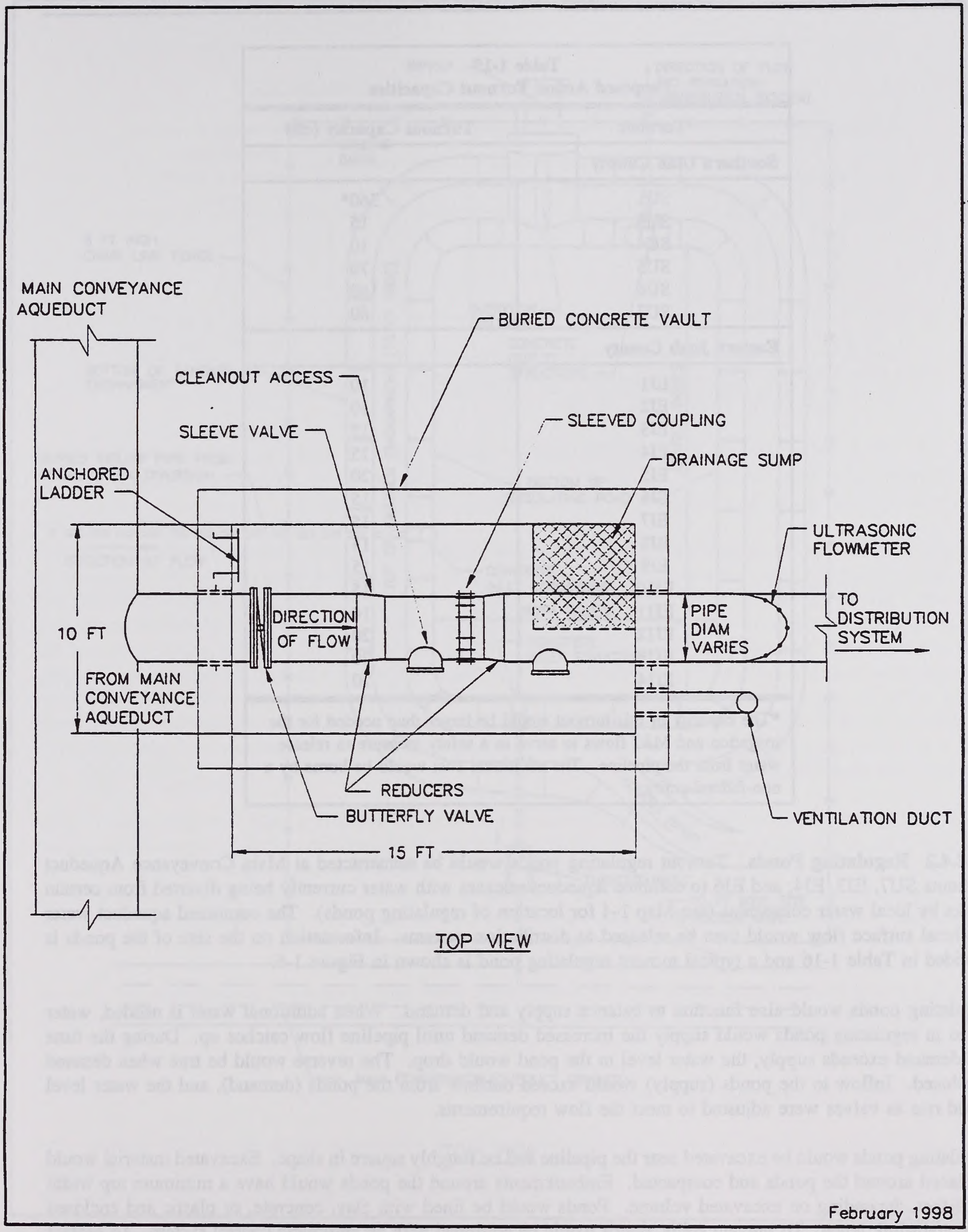


Figure 1-5
Schematic Drawing of Typical Main Conveyance Aqueduct Turnout

Turnout	Turnout Capacity (cfs)
Southern Utah County	
SU1	360*
SU3	15
SU4	10
SU5	70
SU6	160
SU7	60
Eastern Juab County	
EJ1	10
EJ2	10
EJ3	15
EJ4	15
EJ5	20
EJ6	15
EJ7	15
EJ8	15
EJ9	15
EJ10	15
EJ11	10
EJ12	20
EJ13	20
EJ14	20

Table 1-15
Proposed Action Turnout Capacities

*The capacity of this turnout would be larger than needed for the irrigation and M&I flows to serve as a safety measure to release water from the pipeline. The additional cost would be borne by a non-federal entity.

1.6.2.4.2 Regulating Ponds. Turnout regulating ponds would be constructed at Main Conveyance Aqueduct Turnouts SU7, EJ3, EJ4, and EJ6 to combine aqueduct releases with water currently being diverted from certain creeks by local water companies (see Map 1-4 for location of regulating ponds). The combined aqueduct water and local surface flow would then be released to distribution systems. Information on the size of the ponds is provided in Table 1-16 and a typical turnout regulating pond is shown in Figure 1-6.

Regulating ponds would also function to balance supply and demand. When additional water is needed, water stored in regulating ponds would supply the increased demand until pipeline flow catches up. During the time that demand exceeds supply, the water level in the pond would drop. The reverse would be true when demand is reduced. Inflow to the ponds (supply) would exceed outflow from the ponds (demand), and the water level would rise as valves were adjusted to meet the flow requirements.

Regulating ponds would be excavated near the pipeline and be roughly square in shape. Excavated material would be placed around the ponds and compacted. Embankments around the ponds would have a minimum top width of 15 feet, depending on excavated volume. Ponds would be lined with clay, concrete, or plastic and enclosed with chain-link fence. To prevent spills, ponds would be equipped with an automatic control system. To protect pond embankments from failure resulting from overtopping, spillways would be constructed for each pond, as shown in Figure 1-6.

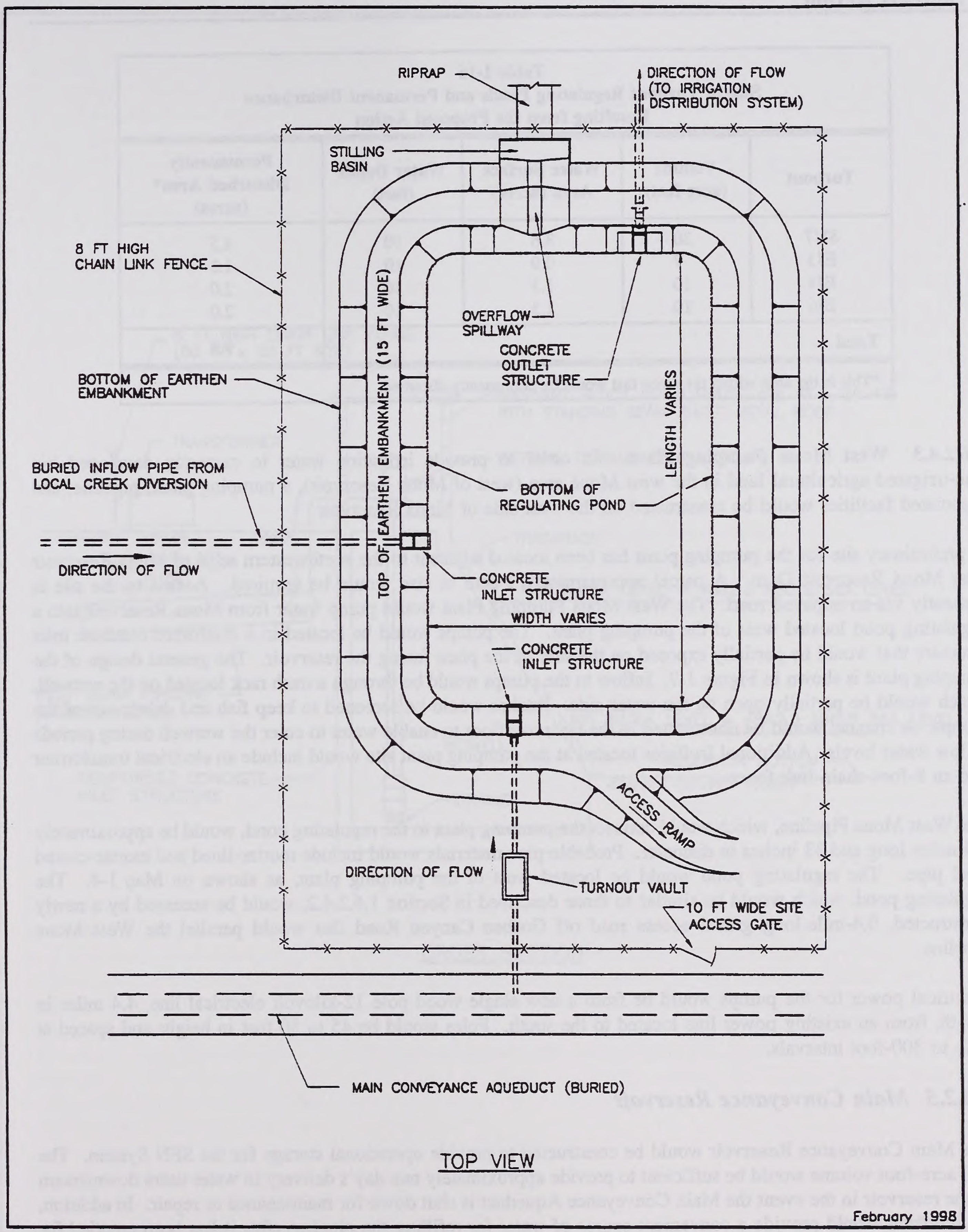


Figure 1-6

Schematic Drawing of Typical Turnout Regulating Pond

Table 1-16 Size of Turnout Regulating Ponds and Permanent Disturbance Resulting from the Proposed Action				
Turnout	**Volume (acre-feet)**	**Water Surface Area (acres)**	**Water Depth (feet)**	**Permanently Disturbed Area* (acres)**
SU7	30	3.6	10	4.5
EJ3	7	0.9	10	1.3
EJ4	10	1.3	10	2.0
EJ6	10	1.3	10	2.0
Total				**9.8**

*This is the area within the fence that would be permanently disturbed.

1.6.2.4.3 West Mona Pumping Plant. In order to provide irrigation water to currently developed but non-irrigated agricultural land in the west Mona area (west of Mona Reservoir), a pumping plant, pipeline, and associated facilities would be constructed on the west side of Mona Reservoir.

A preliminary site for the pumping plant has been located adjacent to the northwestern edge of Mona Reservoir near Mona Reservoir Dam. A parcel approximately 1 acre in size would be required. Access to the site is presently via an unpaved road. The West Mona Pumping Plant would pump water from Mona Reservoir into a regulating pond located west of the pumping plant. The pumps would be located in a reinforced concrete inlet structure that would be partially exposed on the side of the plant facing the reservoir. The general design of the pumping plant is shown in Figure 1-7. Inflow to the pumps would be through a trash rack located on the wetwell, which would be partially open on the water side. Intakes would be screened to keep fish and debris out of the pumps. A channel would be constructed in the reservoir floor to enable water to enter the wetwell during periods of low water levels. Additional facilities located at the pumping plant site would include an electrical transformer and an 8-foot chain-link fence.

The West Mona Pipeline, which would connect the pumping plant to the regulating pond, would be approximately 1.4 miles long and 33 inches in diameter. Probable pipe materials would include mortar-lined and mortar-coated steel pipe. The regulating pond would be located west of the pumping plant, as shown on Map 1-4. The regulating pond, which would be similar to those described in Section 1.6.2.4.2, would be accessed by a newly constructed, 0.4-mile-long gravel access road off Goshen Canyon Road that would parallel the West Mona Pipeline.

Electrical power for the pumps would be from a new single wood pole 12-kilovolt electrical line, 4.4 miles in length, from an existing power line located to the south. Poles would be 45 to 50 feet in height and spaced at 200- to 300-foot intervals.

1.6.2.5 Main Conveyance Reservoir

The Main Conveyance Reservoir would be constructed to provide operational storage for the SFN System. The 300 acre-foot volume would be sufficient to provide approximately one day's delivery to water users downstream of the reservoir in the event the Main Conveyance Aqueduct is shut down for maintenance or repair. In addition, the reservoir would provide a convenient source of water for refilling the pipeline after it has been emptied for maintenance or repair and for regulating flows at those times when pipeline supply and demands are unequal.

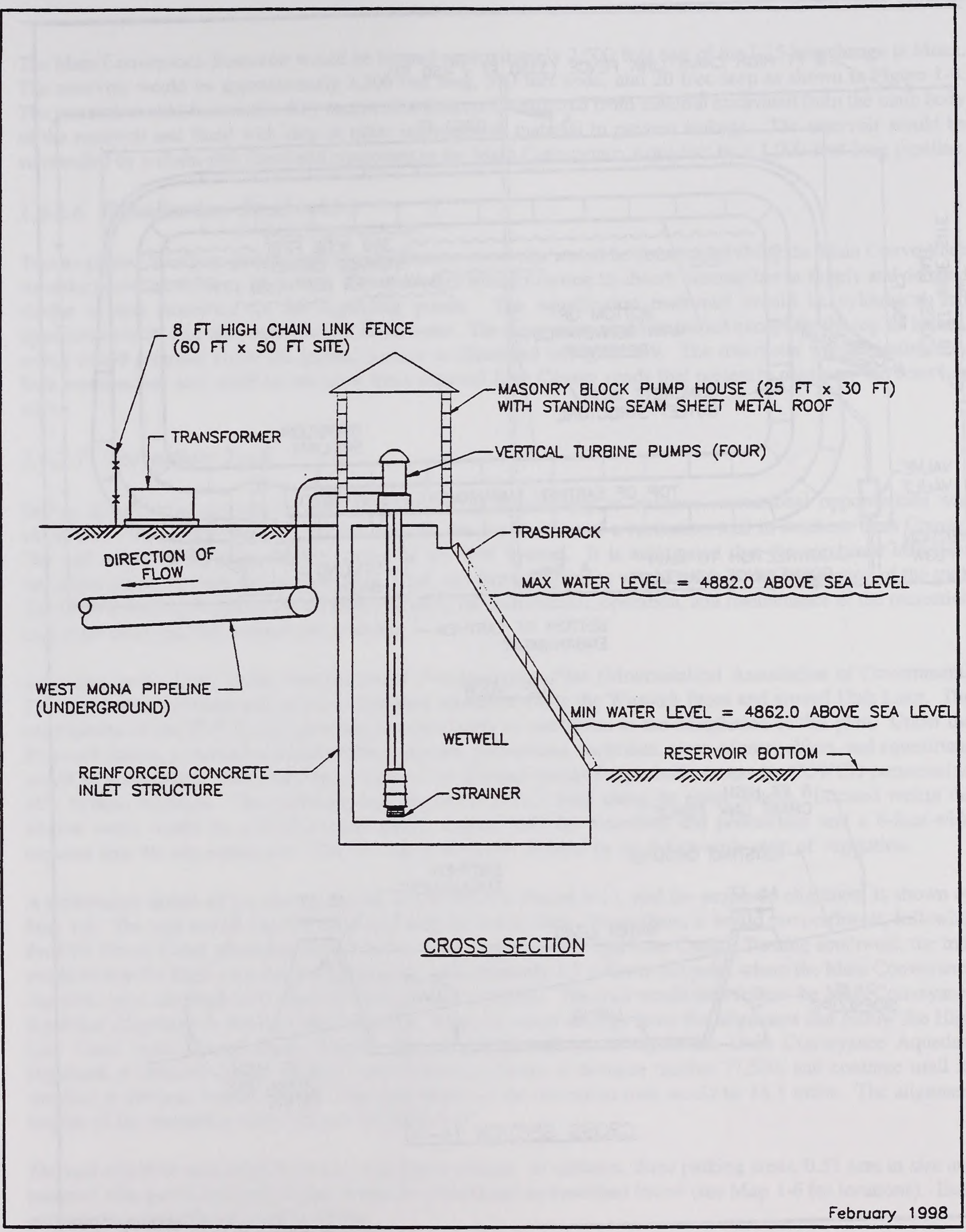


Figure 1-7
Schematic Drawing of West Mona Pumping Plant

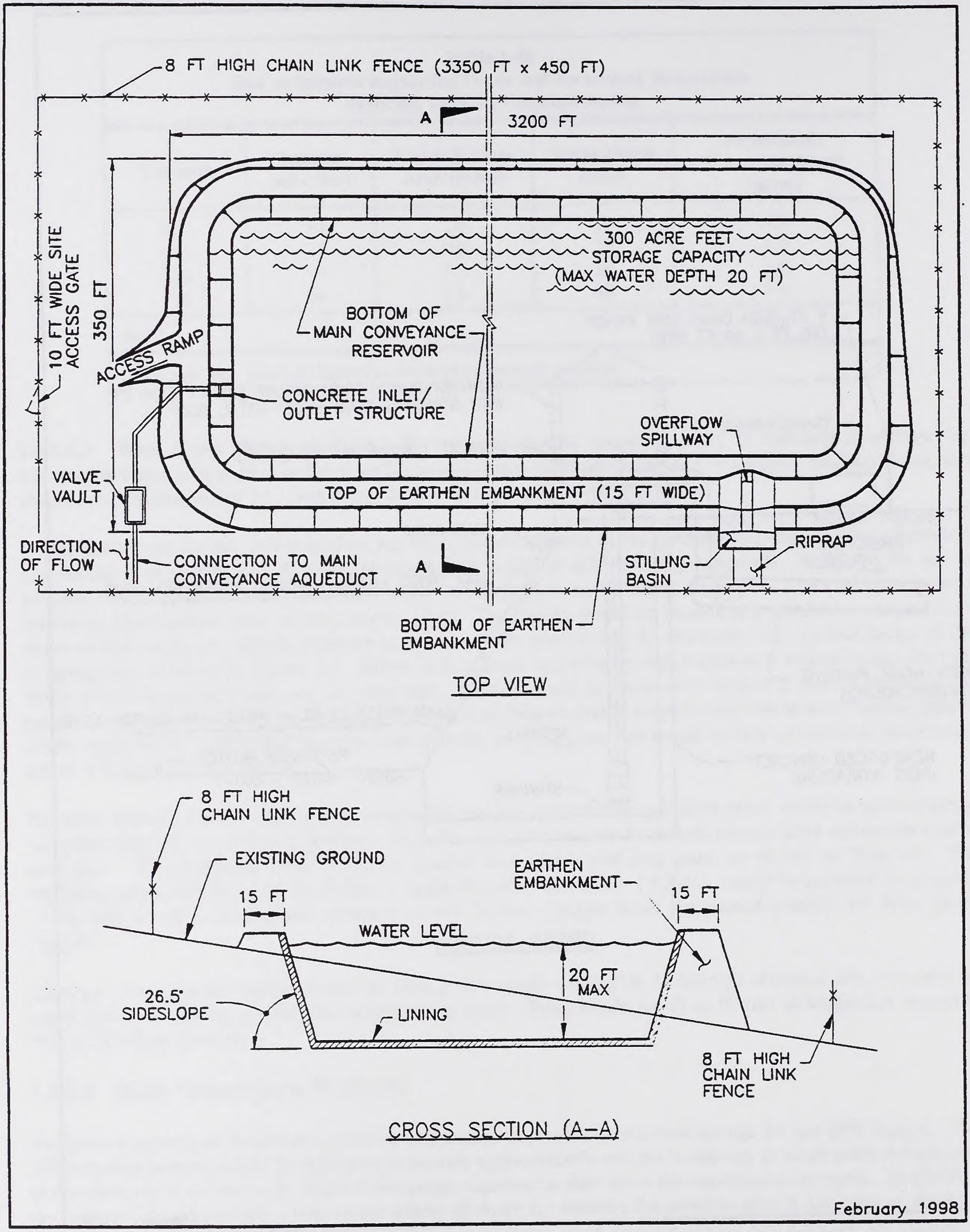


Figure 1-8
Schematic Drawing of Main Conveyance Reservoir

The Main Conveyance Reservoir would be located approximately 2,000 feet east of the I-15 interchange at Mona. The reservoir would be approximately 3,200 feet long, 350 feet wide, and 20 feet deep as shown in Figure 1-8. The reservoir would be contained by earth embankments constructed from material excavated from the main body of the reservoir and lined with clay or other impermeable material to prevent leakage. The reservoir would be surrounded by a chain-link fence and connected to the Main Conveyance Aqueduct by a 1,000-foot-long pipeline.

1.6.2.6 Equalization Reservoirs

Two in-ground 5 million-gallon concrete equalization reservoirs would be constructed along the Main Conveyance Aqueduct (see locations on Map 1-4). The reservoirs would function to absorb mismatches in supply and demand similar to that described for the regulating ponds. The equalization reservoirs would be cylindrical and approximately 30 feet deep and 170 feet in diameter. The reservoirs would be buried except for the top 12 inches, which would protrude above the ground surface as illustrated in Figure 1-9. The reservoirs would require very little maintenance and could be accessed from unpaved Juab County roads that presently pass near the reservoir sites.

1.6.2.7 Recreation Trail

During the planning process for the SFN System, an opportunity to enhance recreational opportunities was identified as part of the Proposed Action, namely, the construction of a recreation trail in southern Utah County. The trail would be an enhancement feature of the SFN System. It is anticipated that the combined efforts of interested citizens groups and various local, State, and federal agencies would result in the completion of the trail. The CUWCD will provide all the necessary funding for construction, operation, and maintenance of the recreation trail if no other funding sources are available.

According to the *Utah Valley Non-Motorized Transportation Plan* (Mountainland Association of Governments 1996), a network of trails and parkways has been identified along the Wasatch Front and around Utah Lake. The construction of the SFN System provides an opportunity to contribute to the completion of this plan. Under the Proposed Action, a recreation trail for hikers, joggers, pedestrians, bicyclists, cross-country skiers, and equestrians would be constructed. Motorized use would not be allowed except for periodic access by CUWCD personnel to SFN System facilities. The recreation trail would be 30 feet wide along its entire length. Located within the 30-foot width would be a 10-foot-wide, paved, asphalt lane for bicyclists and pedestrians and a 6-foot-wide unpaved lane for equestrian use. The two lanes would be divided by an 8-foot-wide strip of vegetation.

A preliminary sketch of the recreation trail is presented in Figure 1-10, and the proposed alignment is shown on Map 1-6. The trail would begin at the Strawberry Diversion Dam. From there, it would run northwest, following the SVP Power Canal alignment for 2.3 miles to the origin of the High Line Canal. Turning southwest, the trail would follow the High Line Canal alignment for approximately 1.3 miles to the point where the Main Conveyance Aqueduct joins the High Line Canal at distance marker 39,000. The trail would then follow the Main Conveyance Aqueduct alignment to distance marker 74,000, where it would diverge from the alignment and follow the High Line Canal north around Rocky Ridge. The recreation trail would rejoin the Main Conveyance Aqueduct alignment at distance marker 76,000, cross Peteetneet Creek at distance marker 77,500, and continue until its terminus at distance marker 94,000. The total length of the recreation trail would be 14.3 miles. The alignment lengths of the recreation trail is shown in Table 1-17.

The trail would be accessible from any road that it crosses. In addition, three parking areas, 0.33 acre in size and surfaced with gravel or crushed rock, would be constructed as described below (see Map 1-6 for locations). Each parking area would have toilet facilities.

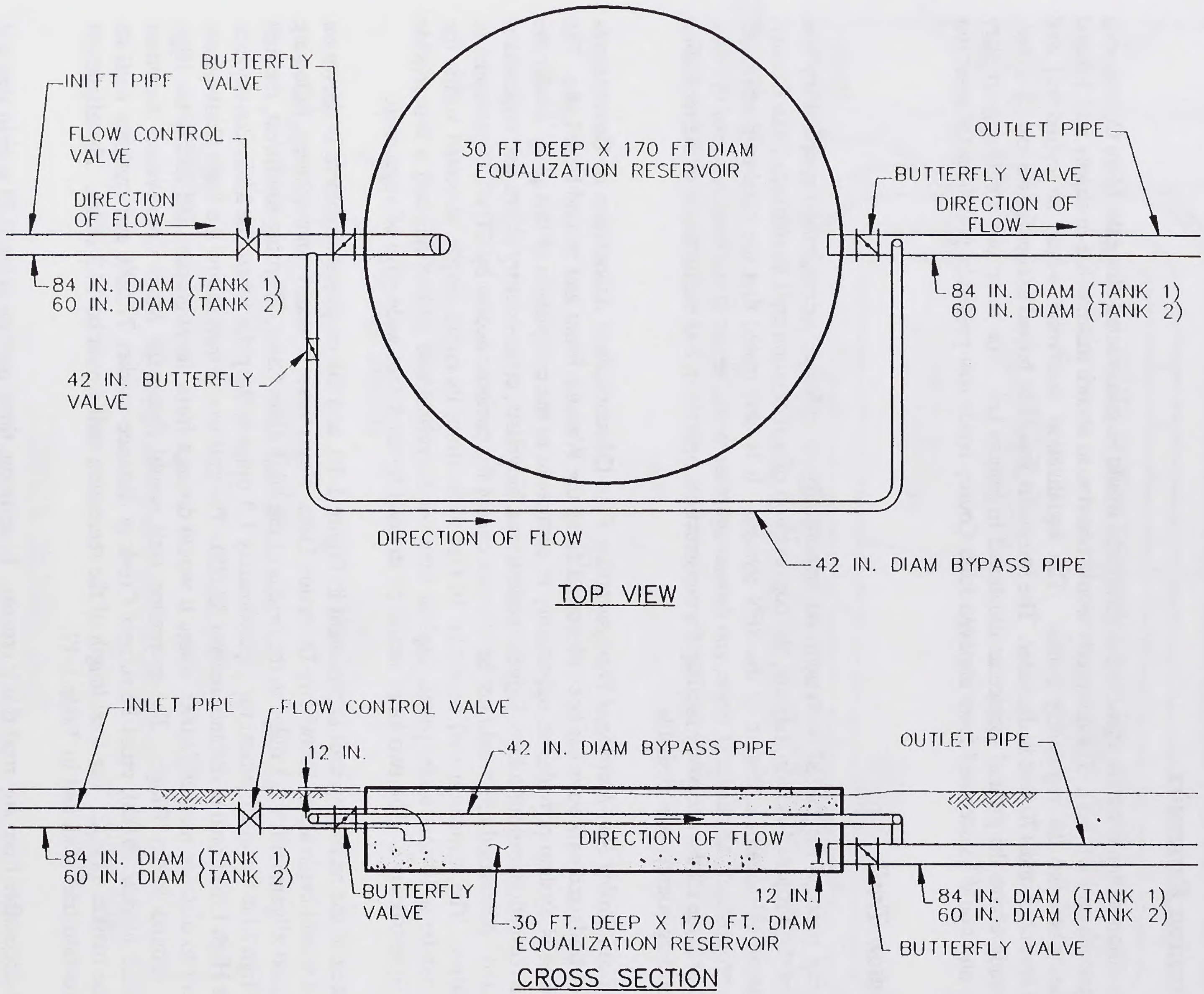


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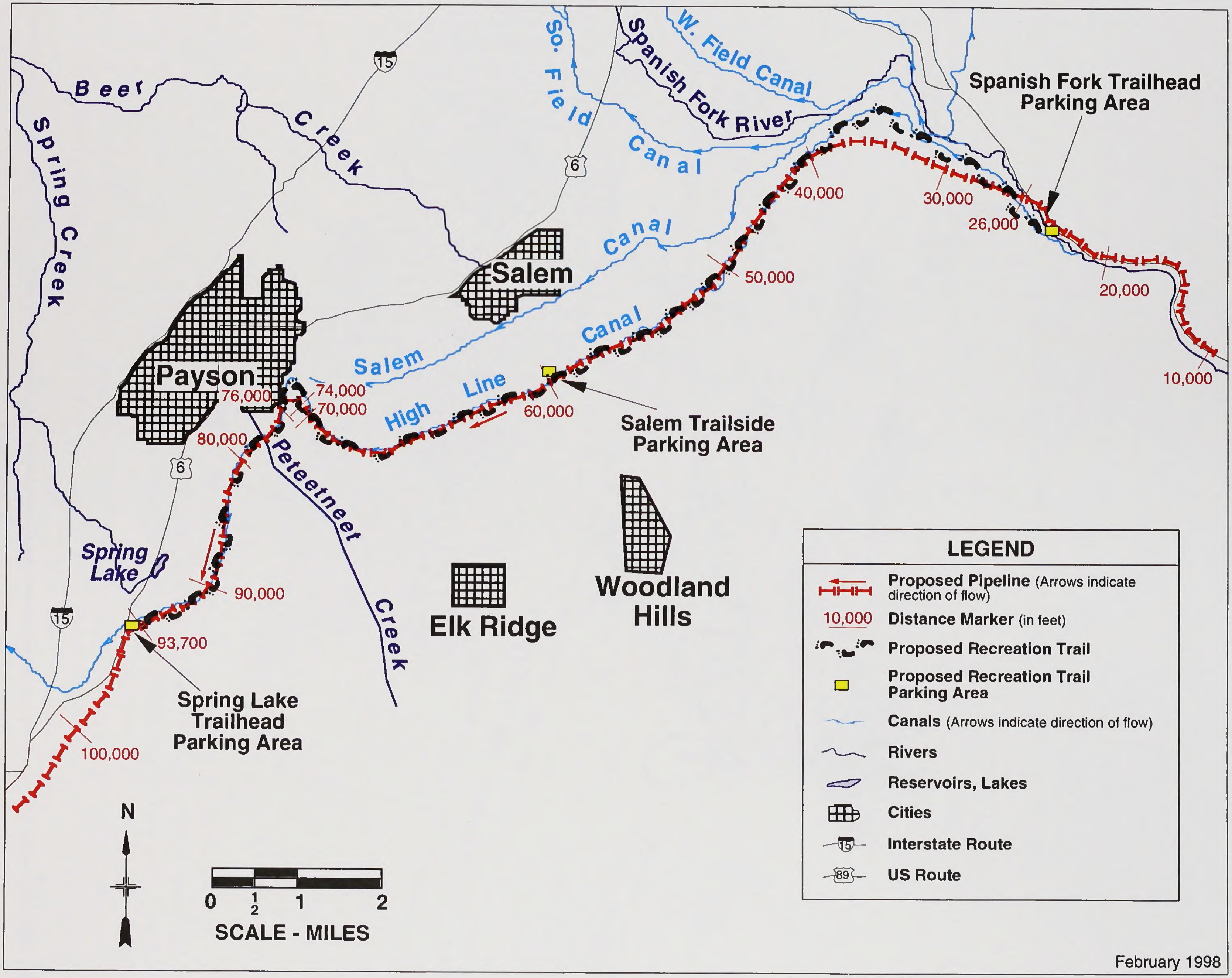
Figure 1–9
Schematic Drawing of Typical Equalization Reservoir



Map 1-6
Recreation Trail Alignment Under the Proposed Action and MCAP Alternative

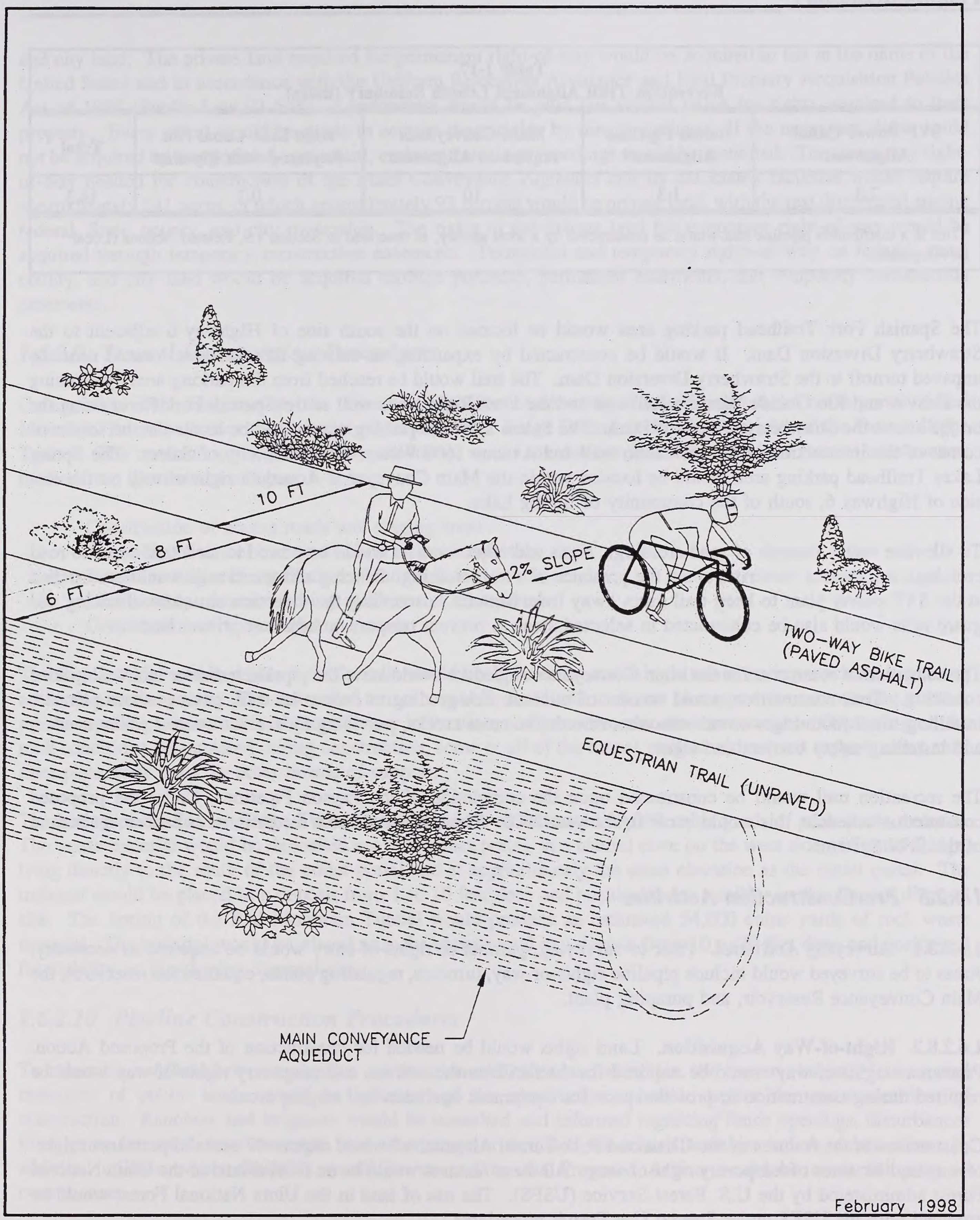


Figure 1-10
Schematic Drawing of Proposed Recreational Trail

Table 1-17 Recreation Trail Alignment Length Summary (miles)				
SVP Power Canal Alignment	**Salem Pipeline Alignment***	**Main Conveyance Aqueduct Alignment**	**High Line Canal Not Replaced with Pipeline**	**Total**
2.3	1.3	10	0.7	14.3
*This is a distribution pipeline that would be constructed by a local agency, as described in Section 1.9, Related Actions (Local Development).				

The Spanish Fork Trailhead parking area would be located on the south side of Highway 6 adjacent to the Strawberry Diversion Dam. It would be constructed by expanding an existing filled-in area located near the unpaved turnoff to the Strawberry Diversion Dam. The trail would be reached from the parking area by crossing the Denver and Rio Grande Western Railroad and the Utah Railroad as well as the Spanish Fork River using the bridge above the Strawberry Diversion Dam. The Salem Trailside parking area would be located at the southeast corner of the intersection of the recreation trail and Avenue 1600 West, south of the city of Salem. The Spring Lakes Trailhead parking area would be located within the Main Conveyance Aqueduct right-of-way on the east side of Highway 6, south of the community of Spring Lake.

To alleviate safety hazards of road crossings, signs and other markers would be posted to alert trail users to road crossings and caution motorists about the presence of a trail crossing. Fencing and guard rails would be installed at the SVP power plant to keep trail users away from hazards surrounding the diversion structure. Fencing and guard rails would also be constructed in selected areas to prevent trespass on adjacent private land.

The construction contractor for the Main Conveyance Aqueduct would leave the pipeline corridor in a well-graded condition. Trail construction would consist of minimal fine-grading to define the trail, paving where planned, installing small footbridges or culverts where needed to cross creeks, providing for erosion control where needed, and installing safety barriers and signs.

The recreation trail would be constructed upon the completion of the Payson Pipeline. Under the proposed construction schedule, this would occur in the year 2003. The trail would be a recreational enhancement feature of the SFN System.

1.6.2.8 Pre-Construction Activities

1.6.2.8.1 Surveying Activities. Prior to surveying, permits or rights-of-entry would be acquired as necessary. Areas to be surveyed would include pipeline rights-of-way, turnouts, regulating ponds, equalization reservoirs, the Main Conveyance Reservoir, and pumping plant.

1.6.2.8.2 Right-of-Way Acquisition. Land rights would be needed for construction of the Proposed Action. Permanent rights-of-way would be required for the facilities themselves, and temporary rights-of-way would be required during construction to provide space for equipment operation and staging areas.

Construction of the features of the "Diamond Fork Tunnel Alternative" would require 47 acres of permanent right-of-way and 81 acres of temporary right-of-way. All these features would be on federal land in the Uinta National Forest administered by the U.S. Forest Service (USFS). The use of land in the Uinta National Forest would be arranged with the USFS under Special Use Permit procedures.

Construction of the Main Conveyance Aqueduct and its associated facilities would require 563 acres of permanent right-of-way of which approximately 66 percent would be on private land and the rest on federal, State, county,

and city land. The private land required for permanent right-of-way would be acquired in fee in the name of the United States and in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646). Landowners would be paid fair market value for rights acquired to their property. Every effort would be made to acquire these rights by direct purchase. If the necessary rights could not be acquired by a negotiated agreement, eminent domain proceedings would be instituted. The temporary right-of-way needed for construction of the Main Conveyance Aqueduct and its associated facilities would require approximately 541 acres, of which approximately 93 percent would be private land, with the rest distributed among federal, State, county, and city ownership. The rights to use private land for temporary right-of-way would be acquired through temporary construction easements. Permanent and temporary rights-of-way on federal, state, county, and city land would be acquired through purchase, permanent easements, and temporary construction easements.

1.6.2.9 Tunnel Construction Procedures

Construction of the tunnels along the "Diamond Fork Tunnel Alternative" would begin at the outlet portal of Red Mountain Tunnel, advance to the outlet portal of Tanner Ridge Tunnel, and end at the inlet of the Tanner Ridge Tunnel. The construction sequence for each tunnel would involve the following activities (tunnel construction methods are illustrated on Figure 1-11):

- Construction of access roads and staging areas
- Assembly of tunnel boring machines at outlet portals
- Tunnel boring and installation of tunnel lining
- Disassembly of tunnel boring machines at inlet portals
- Construction of tunnel inlet structures

The Tanner Ridge and Red Mountain Tunnels would likely be excavated using a tunnel boring machine, beginning at the downstream ends. The excavated tunnel would be lined with concrete to support the surrounding ground, prevent spalling of the rock and groundwater infiltration, and provide a smooth inner surface. Depending on the rock conditions encountered during construction, some or all of the tunnel walls could require support using steel liner plate, rock bolts, or other means of support.

The boring of the Tanner Ridge Tunnel would produce an estimated 29,000 cubic yards of rock waste material. The waste material would be deposited near the outlet portal, in a natural cove on the west side of Tanner Ridge, lying directly to the south of the outlet portal and at approximately the same elevation as the outlet portal. The material would be placed in a deposit from 1 to 10 feet deep and positioned for stability on the sloping disposal site. The boring of the Red Mountain Tunnel would produce an estimated 54,000 cubic yards of rock waste material. The material would be placed near the outlet portal in a deposit from 10 to 20 feet deep and positioned for stability on the sloping disposal site.

1.6.2.10 Pipeline Construction Procedures

To minimize conflicts between pipeline construction and other land activities, the owners, tenants, lessees, and managers of public lands would be informed of the construction schedule before the commencement of construction. Ranchers and irrigators would be consulted and informed regarding fence openings, disturbances to range or farmland, improvements, and other range or farmland use-related activities before construction. In addition, utilities whose facilities would be crossed by the Proposed Action would be contacted prior to construction.

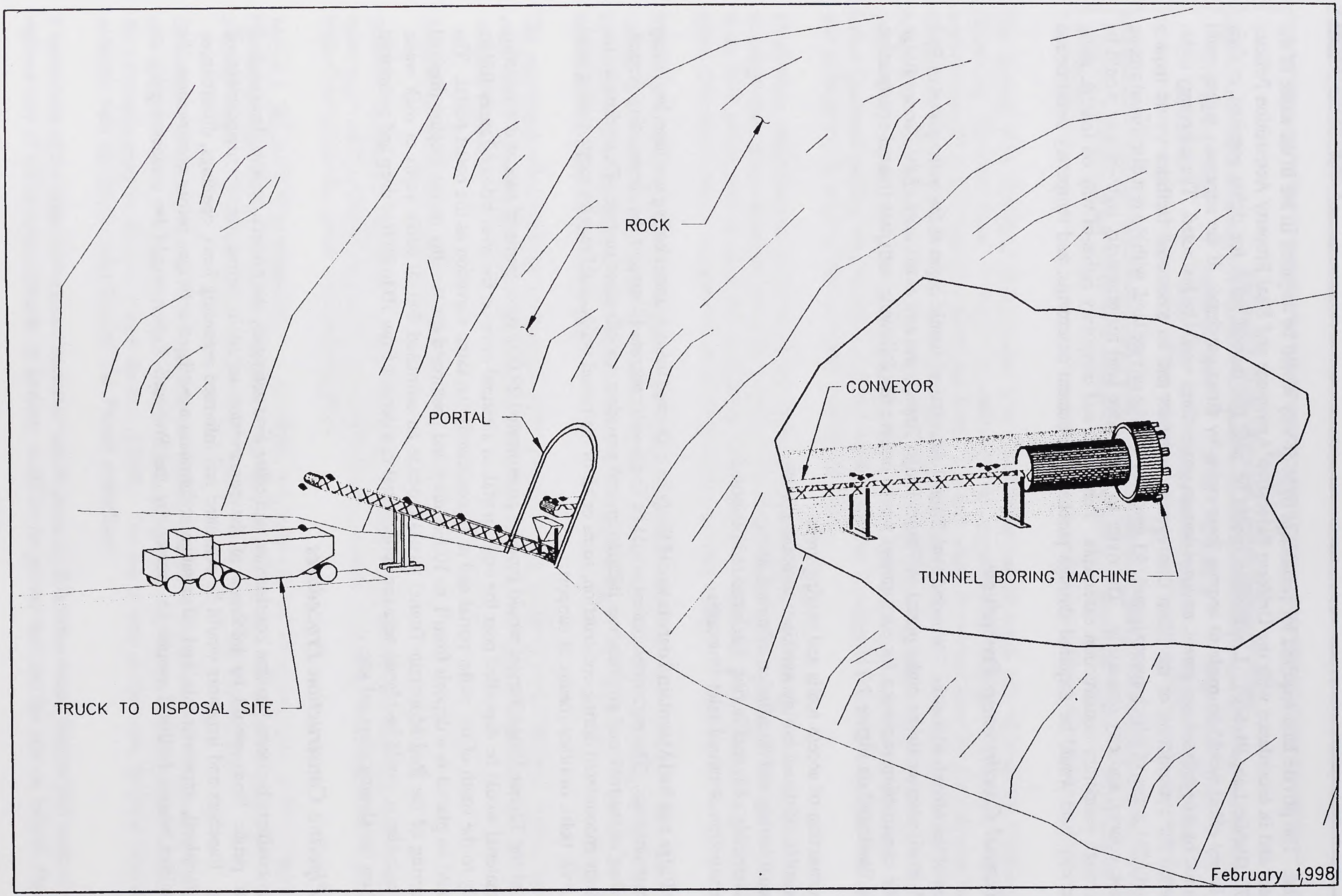


Figure 1-11
Schematic Drawing of Typical Tunnel Construction

Fences along the right-of-way would be braced before any opening to a fence is made. Access and livestock control would be employed during construction to reduce impacts on other uses of the land. If damaged, barriers for livestock control would be replaced by adequate measures of equal effectiveness. Existing livestock access to water and adjacent grazing areas would not be prevented unless agreed to by the owner and/or lessee in advance. Fences, gates, and cattle guards would be restored to their original condition or replaced when construction in the area has been completed. If disturbed, all highway and road surfaces would be restored to their former condition.

Construction activities for the Proposed Action would be performed in accordance with *Final Draft Nonpoint Source Water Pollution Control Plan of Hydrologic Modifications in Utah* (Robinson 1994). The measures identified in this plan specify construction practices where there is potential for disturbing stream channels, riparian areas, and floodplains. These practices are designated as the State of Utah's Best Management Practices for nonpoint source water pollution control.

The possibility of accidental releases of materials into surface waters would be managed in accordance with spill containment and countermeasure requirements of the CUWCD's construction specifications. Such specifications would include worker education, incident reporting, and remediation provisions in the event of a spill.

The general steps taken when constructing a buried pipeline are illustrated on Figure 1-12. The number of acres temporarily and permanently disturbed by the "Diamond Fork Tunnel Alternative," Main Conveyance Aqueduct, and associated features are shown in Table 1-18. The typical noise levels and air emissions for the construction equipment that would be used for the Proposed Action are shown in Tables 1-19 and 1-20.

1.6.2.10.1 Construction Sequence. Construction of the Proposed Action pipelines would occur in the following sequence:

- Constructing access roads
- Clearing and grading pipeline alignments
- Excavating trench for pipe installation
- Hauling pipe to construction sites
- Placing pipe along trenches
- Placing pipe in trenches and connecting pipe
- Backfilling trenches and grading
- Cleaning and restoring areas disturbed by construction
- Constructing recreation trail

1.6.2.10.2 Clearing and Grading. Clearing would be performed in accordance with permits issued by land-administering agencies or agreements with each landowner. Vegetation and obstacles would be cleared to the extent necessary to allow safe and efficient use of construction equipment. Debris from right-of-way preparation would be disposed in accordance with any applicable regulations, permits, or landowner agreements. Right-of-way grading would be limited to that necessary to ensure the safe and efficient movement of machinery. Construction of temporary bridges or culverts across creeks on the right-of-way could be required to ensure vehicle safety and to reduce harmful environmental effects. Grading would be performed to minimize effects on drainage and slope stability. On steep terrain where the right-of-way must be terraced to provide a level temporary work area, the area would be restored after construction to approximate original contours.

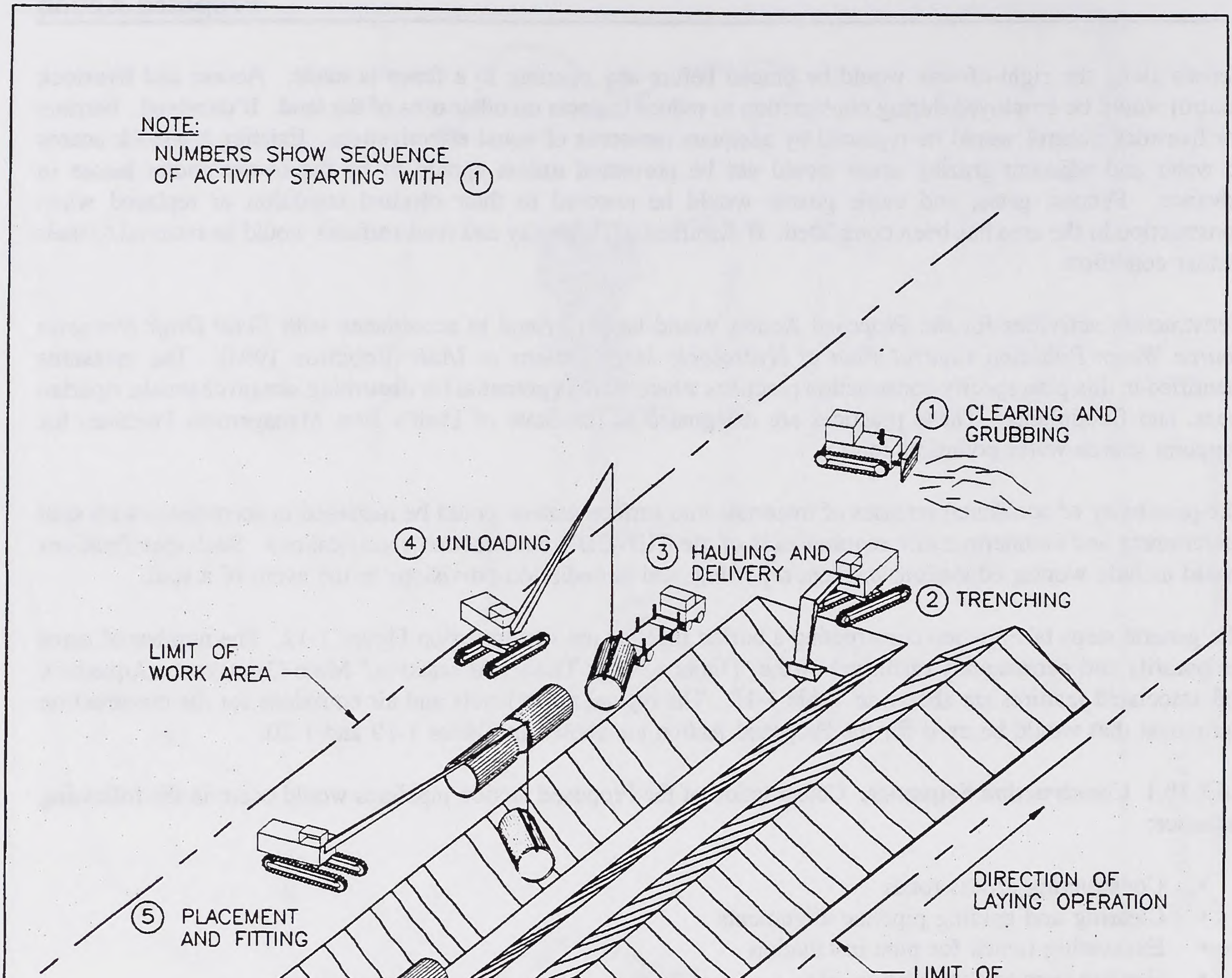


Figure 1-12
Schematic Drawing of Typical Pipeline Construction Procedures

Table 1-18
Land Disturbance Resulting from the Proposed Action (acres)

Project Feature	Land Area Disturbed During Construction	Land Area to be Revegetated	Land Area Permanently Disturbed
"Diamond Fork Tunnel Alternative"			
Tanner Ridge Tunnel	8.0	6.5	1.5
Diamond Fork Siphon	22.5	22.5	0.0
Red Mountain Tunnel	9.5	8.5	1.0
Red Hollow Pipeline	36.5	36.5	0.0
Access Roads	34.5	27.5	7.0
Construction Staging Areas	17.0	17.0	0.0
Subtotal	**128.0**	**118.5**	**9.5**
Main Conveyance Aqueduct and Associated Features			
Pipeline and Turnouts	948.4	907.7	40.7[a]
Regulating Ponds	9.8	0.0	9.8
West Mona Pumping Plant	34.3	30.7	3.6
Equalization Reservoirs	6.0	4.0	2.0
Main Conveyance Reservoir[b]	38.4	3.4	48.0
Access Roads	4.6	0.0	0.0
Construction Staging Areas	48.0	48.0	0.0
Recreation Trail[c]	48.0	0.0	14.8
Subtotal	**1,104.3**	**998.4**	**105.9**
Total	**1,232.3**	**1,116.9**	**115.4**

[a]Includes 38.2 acres of permanent disturbance related to the recreation trail and 2.5 acres of permanent disturbance related to the turnouts.
[b]Includes 3.4 acres of temporary disturbance for connecting pipeline.
[c]Does not include 38.2 acres associated with pipeline and turnouts.

Table 1-19
Construction Equipment and Typical Noise Levels

Equipment	Horsepower	Fuel Type	Daily Usage	Range of Noise Levels at 50 Feet (in decibels [dBA])	Nominal Noise Level at 50 Feet (in dBA)
Backhoe	70	Diesel	8 hours	71-93	85
Boring and Jacking Equipment	60	Diesel	8 hours	68-81	76
Compactor (Dual Drum Asphalt)	80	Diesel	8 hours	71-93	85
Compactor (Cat 816)	210	Diesel	8 hours	72-96	84
Compactor (Padded Drum Vibratory)	200	Diesel	8 hours	75-84	80
Compactor (21" Whacker)	5	Diesel	8 hours	84-90	86
Compressor (Air)	85	Diesel	8 hours	68-87	78
Crane 60 ton (Link-Belt)	180	Diesel	8 hours	75-95	80
Dozer (Cat D4)	80	Diesel	8 hours	72-96	86
Dozer (Cat D6)	150	Diesel	8 hours	72-96	86
Dozer (Cat D8)	300	Diesel	8 hours	72-96	86
Excavator (Cat 235c)	250	Diesel	8 hours	71-93	85
Excavator (Cat 245c)	360	Diesel	8 hours	71-93	85
Generator	40	Diesel	8 hours	69-81	75
Grader(Cat 14G)	200	Diesel	8 hours	73-95	85
Loader (Bobcat Skid Steer)	40	Diesel	8 hours	69-81	75
Loader (Cat 966F)	220	Diesel	8 hours	71-96	82
Loader (Cat 988)	400	Diesel	8 hours	71-96	82
Loader (Cat 992)	690	Diesel	8 hours	71-96	82
Pump (Concrete)	100	Diesel	8 hours	74-84	82
Pump (Water)	70	Diesel	8 hours	69-80	74
Truck (10,000 lb., 4X4, Flatbed)	180	Gas	50 mi/day	70-92	82
Truck (4X2 Pickup)	130	Gas	50 mi/day	76-85	80
Truck (6x4 Dump)	235	Diesel	50 mi/day	70-92	85
Truck (Bottom Dump)	260	Diesel	50 mi/day	70-92	85
Truck (Concrete Mixer)	250	Diesel	50 mi/day	70-90	85
Truck (Grout)	180	Diesel	8 hours	70-92	82
Truck (On-Hwy, 3,500 gal.)	250	Diesel	8 hours	70-92	85
Truck (Pipe Delivery)	260	Diesel	50 mi/day	70-92	85
Truck (Welding)	180	Gas	8 hours	70-92	82

Table 1-20
Monthly Equipment Emissions (lb/month)

Equipment	Hours of Use	CO[a]	Reactive Organic Gases	NO_x[b]	SO_2[c]	PM_{10}[d]
Backhoe	176	184.800	36.960	271.040	24.640	24.640
Boring and Jacking Equipment	176	211.200	31.680	253.440	21.120	31.680
Compactor (Dual Drum Asphalt)	176	98.560	28.160	281.600	28.160	28.160
Compactor (Cat 816)	176	258.720	73.920	739.200	73.920	73.920
Compactor (Padded Drum Vibratory)	176	246.400	70.400	704.000	70.400	70.400
Compressor (Air)	176	9.680	1.760	15.840	1.760	1.760
Crane 60 ton (Link-Belt)	176	285.120	95.040	728.640	63.360	95.040
Dozer (Cat D4)	176	140.800	28.160	295.680	28.160	14.080
Dozer (Cat D6)	176	264.000	52.800	554.400	52.800	26.400
Dozer (Cat D8)	176	528.000	105.600	1108.800	105.600	52.800
Excavator (Cat 235c)	176	484.000	44.000	1056.000	88.000	132.000
Excavator (Cat 245c)	176	696.960	63.360	1520.640	126.720	190.080
Generator	176	77.440	0.000	126.720	14.080	14.080
Grader (Cat 14G)	176	281.600	105.600	739.200	70.400	70.400
Loader (Bobcat Skid Steer)	176	105.600	21.120	154.880	14.080	14.080
Loader (Cat 966F)	176	580.800	116.160	851.840	77.440	77.440
Loader (Cat 988)	176	1056.000	211.200	1548.800	140.800	140.800
Loader (Cat 992)	176	1821.600	364.320	2671.680	242.880	242.880
Pump (Concrete)	176	193.600	35.200	316.800	35.200	35.200
Pump (Water)	176	135.520	24.640	221.760	24.640	24.640
Truck (10,000 lb., 4X4, Flatbed)	176	158.400	15.840	15.840	0.000	2.218
Truck (4X2 Pickup)	176	114.400	11.440	11.440	0.000	1.602
Truck (6x4 Dump)	176	248.160	82.720	868.560	82.720	82.720
Truck (Bottom Dump)	176	274.560	91.520	960.960	91.520	91.520
Truck (Concrete Mixer)	176	264.000	88.000	924.000	88.000	88.000
Truck (Grout)	176	190.080	63.360	665.280	63.360	63.360
Truck (On-Hwy, 3,500 gal.)	176	264.000	88.000	924.000	88.000	88.000
Truck (Pipe Delivery)	176	274.560	91.520	960.960	91.520	91.520
Truck (Welding)	176	158.400	15.840	15.840	0.000	2.218
Total Monthly Emissions		**2,227.280**	**524.480**	**4,952.640**	**469.920**	**418.880**

[a]Carbon monoxide
[b]Nitrogen oxides
[c]Sulfur dioxide
[d]Particulate matter less than 10 microns in aerodynamic diameter

1.6.2.10.3 Pipe Trench Excavation. The Diamond Fork Siphon and Red Hollow Pipeline, features of the "Diamond Fork Tunnel Alternative," would be 96-inch-diameter pressure pipelines with a depth of cover averaging about 8 feet. The pipeline trenches would be excavated using crawler-tracked excavators. In order to minimize the width of the trench, shoring would be used to support the trench walls and protect the construction workers. Jackhammers and blasting may be required to excavate the trench in rock. Much, if not all, of the excavated material would be unsuitable for pipe backfill and would be disposed along the pipe trenches in ways that blend with adjacent terrain. Pipe would be installed in lengths up to 40 feet and would be transported from a Diamond Fork Road staging area near Monks Hollow to the work site by flatbed truck and/or specially outfitted loaders. Pipe bedding and special backfill material would be imported from sources along the Spanish Fork River. Excavation of the pipe trenches for the Diamond Fork Siphon and Red Hollow Pipeline would produce an estimated 85,000 cubic yards of earth and rock material, most of which would need to be disposed. Arrangements for disposal, which would be formulated with the USFS, would utilize existing disposal areas in Diamond Fork Canyon as much as possible.

The Main Conveyance Aqueduct would be installed in a trench with a minimum cover of 4 feet. A typical pipe trench is illustrated on Figure 1-13. Deeper burial would be needed at stream crossings and in other areas to safeguard the pipe. Prior to trenching, topsoil in vegetated areas would be removed by using scrapers, bulldozers, or other equipment and stockpiled for later replacement over the pipe trench. The length of trench open at any one time would be limited to 600 feet. In populated areas, excavations would be security-protected at the end of each day.

Pipe trenches would be excavated by excavator, trencher, or backhoe, and the excavated material would be placed adjacent to the trench in a manner that would not alter drainages. In areas with sensitive resources (e.g., wetlands), the excavated material would be removed by truck and stockpiled in a less sensitive area. In areas where the trench must be excavated in rock (e.g., Spanish Fork Canyon), rippers, hammers, blasting, or other specialized equipment could be required. If blasting is required, all blasting operations, including transportation, storage, and handling of explosives and blasting agents, would be in conformance with county, State, and federal regulations.

Because of the narrow shoulder along portions of Highway 6 in Spanish Fork Canyon, some sections of the pipeline would be placed beneath the road. During construction, it would be necessary to close one traffic lane and remove portions of the road surface as shown in Figure 1-14. For the most part, existing roadway widths east of Covered Bridge would be adequate to permit two-way traffic through the work zone. North of Covered Bridge, however, the existing roadway is narrower, and a single, one-way traffic lane would be necessary for an estimated 1,000-foot distance through the work zone. Appropriate traffic control devices, including median barriers, signage, channelizing devices, and flagmen, would be used to control traffic. Because of the restricted width of the work area, stockpiling of excavated material and pipe along the trench would not be permitted. The excavated materials would be removed by truck, and imported backfill materials delivered at appropriate intervals. The highway and shoulder would be restored to its original condition following construction.

1.6.2.10.4 Pipe Installation. The pipe would be steel pipe with concrete lining. Pipe diameters for the features of the "Diamond Fork Tunnel Alternative" would be 96 inches; pipe diameters for the Main Conveyance Aqueduct would range from 108 inches at its beginning to 30 inches at its terminus. The pipe would be shipped from the manufacturer by rail and/or truck to the job site in lengths up to 40 feet and unloaded by cranes or tractors fitted with side booms, as shown in Figure 1-12.

Pipe would be placed in the excavated trench by crane or pipelayer (side-boom tractor) and connected to the previously laid sections of pipe. Pipe would be connected by pushing it into place and welding the pipe together. If local materials are unsuitable for pipe bedding, imported bedding material would be used. Sections of pipe would be coated inside and out with cement mortar to protect steel from corrosion.

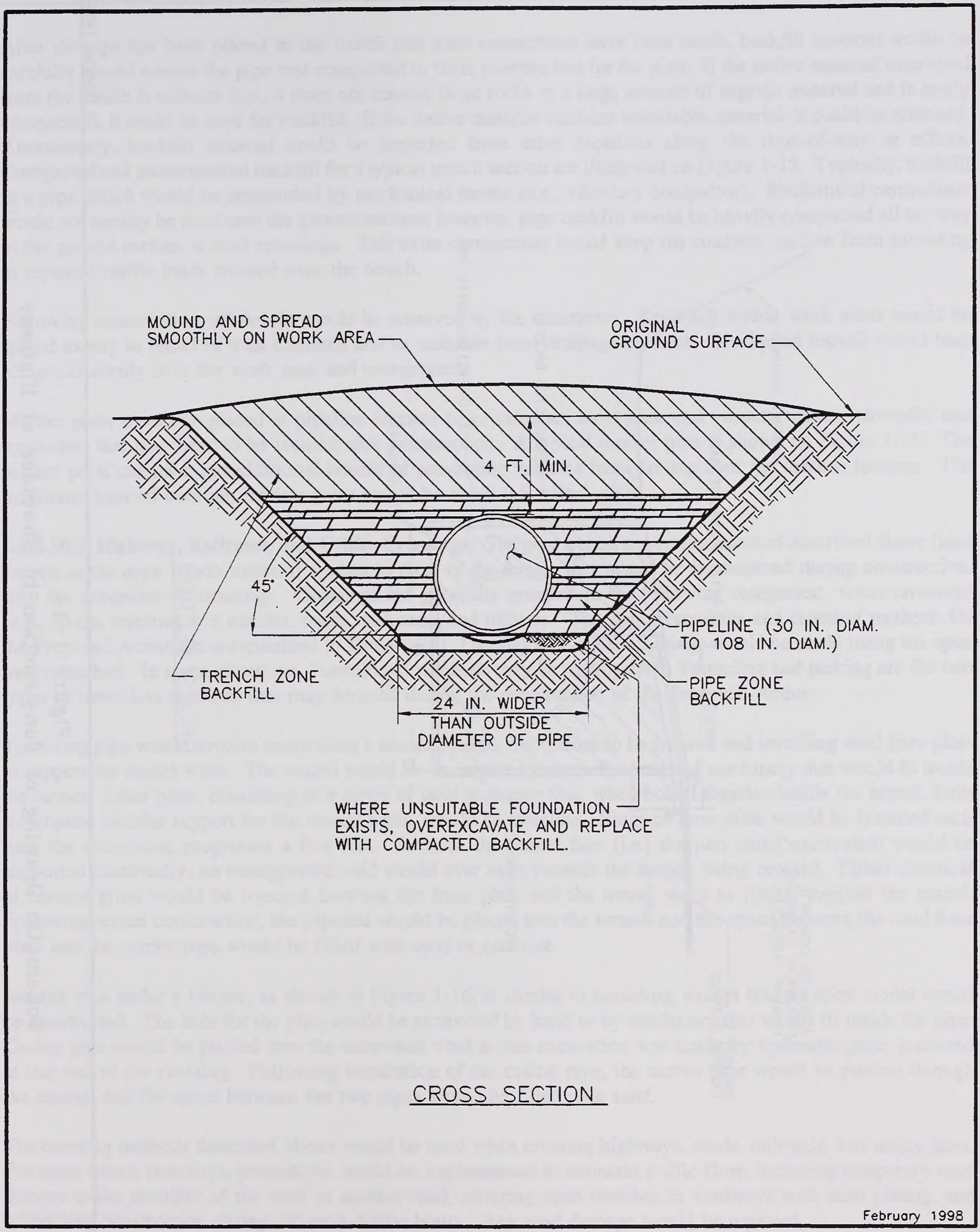


Figure 1-13
Schematic Drawing of Typical Pipe Trench Cross Section

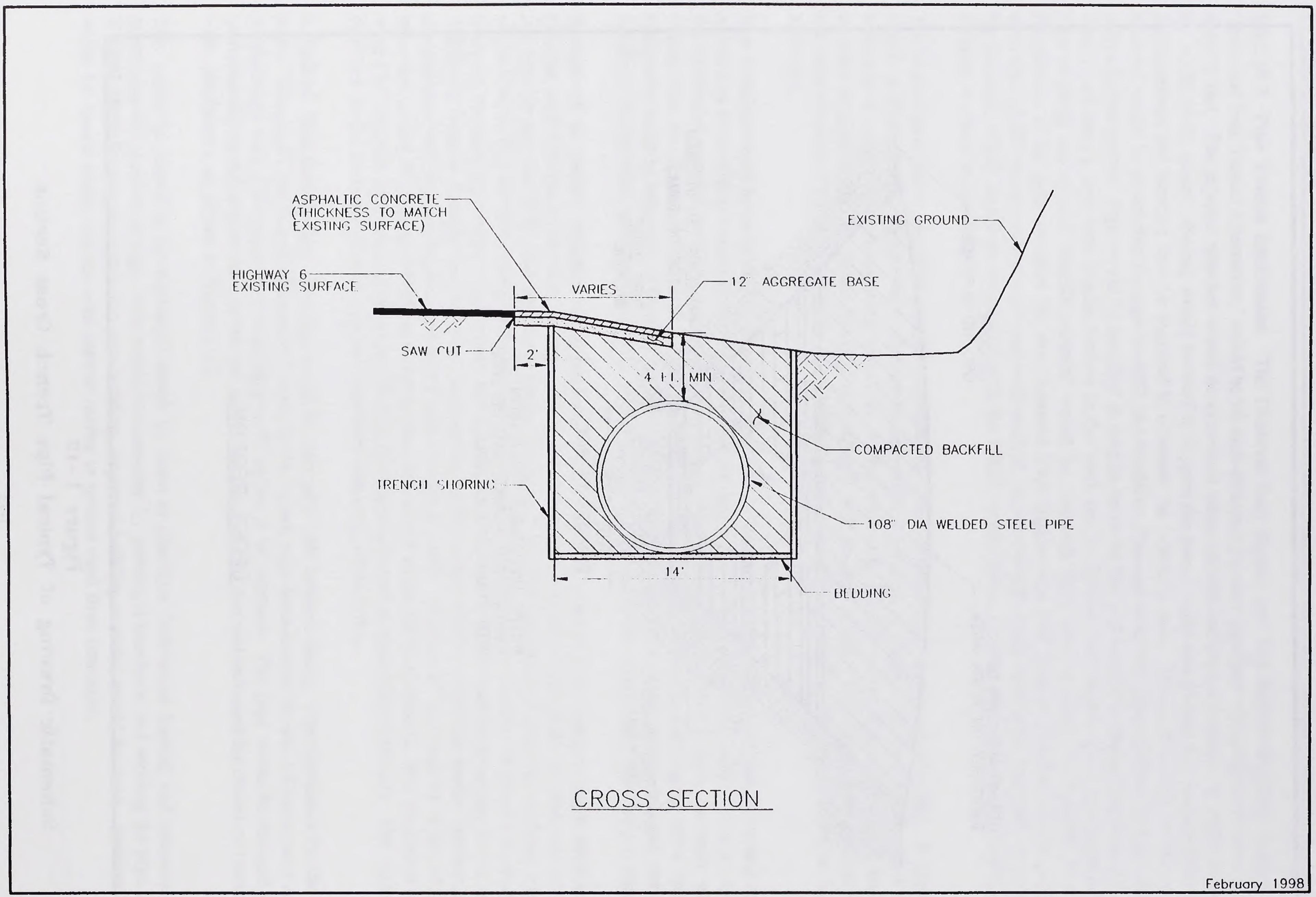


Figure 1–14
Schematic Drawing of Construction in Shoulder of Highway

After the pipe has been placed in the trench and joint connections have been made, backfill material would be carefully placed around the pipe and compacted to form a secure bed for the pipe. If the native material excavated from the trench is suitable (i.e., it does not contain large rocks or a large amount of organic material and is easily compacted), it could be used for backfill. If the native material contains unsuitable material, it could be screened. Alternatively, backfill material could be imported from other locations along the right-of-way or offsite. Compacted and uncompacted backfill for a typical trench section are illustrated on Figure 1-13. Typically, backfill in a pipe trench would be compacted by mechanical means (e.g., vibratory compactor). Mechanical compaction would not usually be used near the ground surface; however, pipe backfill would be heavily compacted all the way to the ground surface at road crossings. This extra compaction would keep the roadway surface from subsiding as repeated traffic loads crossed over the trench.

Following construction, all debris would be removed by the contractor. Spoil left within work areas would be spread evenly to blend in with contours and to maintain local drainage patterns. Stockpiled topsoil would then be spread evenly over the work area and revegetated.

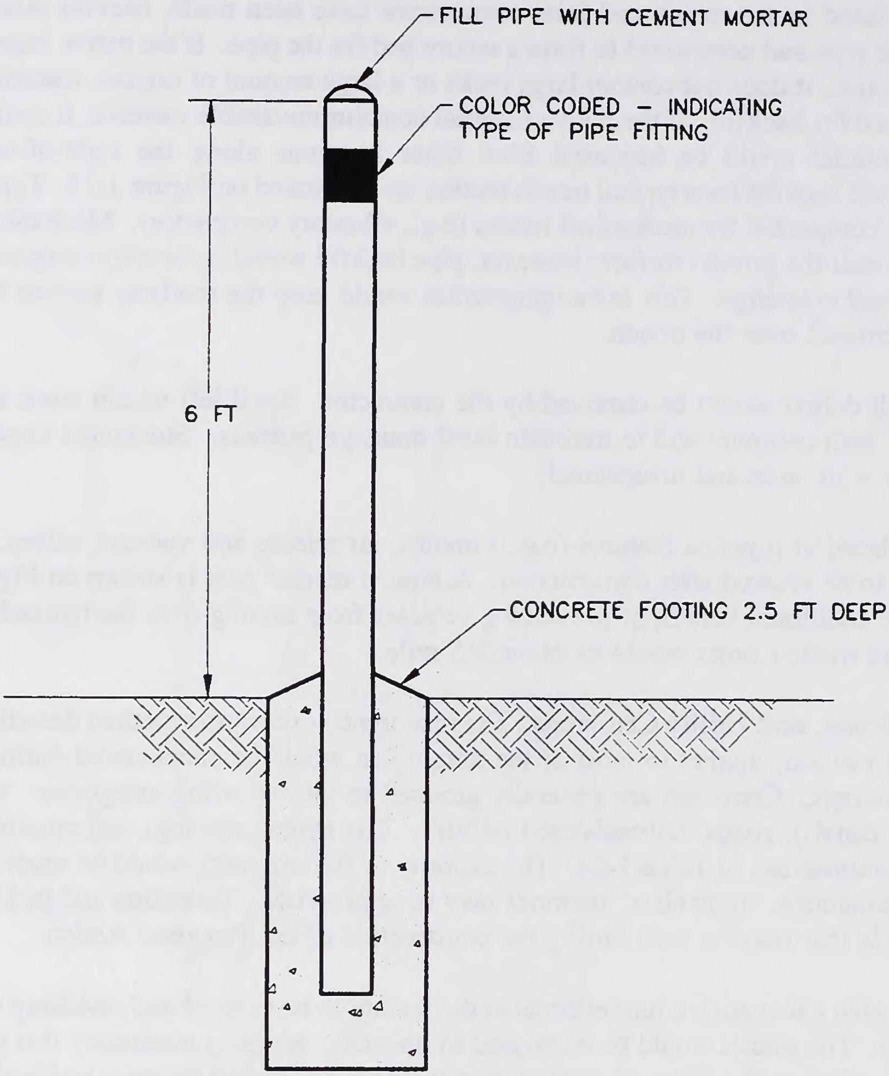
Marker posts would be placed at pipeline features (e.g., turnouts, air release and vacuum valves, blowoffs, and manholes) that may need to be located after construction. A typical marker post is shown on Figure 1-15. The marker posts can have the additional benefit of preventing vehicles from driving over the marked features. The maximum interval between marker posts would be about 0.5 mile.

1.6.2.10.5 Highway, Railroad, and Utility Crossings. The pipe trench excavation method described above (also known as the open trench method) applies to most of the terrain that would be encountered during construction, with the exception of crossings. Crossings are generally grouped in the following categories: water crossings (e.g., rivers, streams, and canals), roads, railroads, and utilities. The major crossings and crossing methods for the Proposed Action are summarized in Table 1-21. The majority of the crossings would be made using the open trench method. In some situations, "trenchless" methods may be appropriate. Tunneling and jacking are the two types of trenchless methods that may be used during the construction of the Proposed Action.

Tunneling pipe would involve excavating a tunnel beneath the feature to be crossed and installing steel liner plate to support the tunnel walls. The tunnel would be excavated by specially designed machinery that would fit inside the tunnel. Liner plate, consisting of a series of steel segments that, when bolted together inside the tunnel, form a complete circular support for the tunnel walls, would be installed. Rings of liner plate would be installed each time the excavation progresses a few feet. Because the tunnel face (i.e., the part being excavated) would be supported continually, no unsupported void would ever exist beneath the feature being crossed. Either chemical or cement grout would be injected between the liner plate and the tunnel walls to further support the tunnel. Following tunnel construction, the pipeline would be placed into the tunnel, and the space between the steel liner plate and the carrier pipe would be filled with sand or concrete.

Jacking pipe under a feature, as shown in Figure 1-16, is similar to tunneling, except that no open tunnel would be constructed. The hole for the pipe would be excavated by hand or by machinery that would fit inside the pipe. Casing pipe would be pushed into the excavated void as the excavation was made by hydraulic jacks anchored at one end of the crossing. Following installation of the casing pipe, the carrier pipe would be pushed through the casing, and the space between the two pipes would be filled with sand.

The crossing methods described above would be used when crossing highways, roads, railroads, and utility lines. For open trench crossings, procedures would be implemented to maintain traffic flow, including temporary road detours to the shoulder of the road or another road, covering open trenches in roadways with steel plating, and scheduling construction during off-peak traffic hours. Any road damage would be repaired.



COLOR CODE FITTING TYPE	STRIPE COLOR
ISOLATION BURIED VALVE	RED
AIR VALVE	BLUE
TEMPORARY BULKHEAD	GREEN
FLANGED TEE & BLIND FLANGE	BLACK

NOTES:
1. LOCATE ONE MARKER POST AT EACH BURIED PIPE FITTING.
2. POSTS WILL BE A 4 IN. PIPE FILLED WITH CEMENT MORTAR.

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Figure 1-15
Schematic Drawing of Typical Marker Post for Buried Pipeline

Table 1-21
Major Crossings and Crossing Methods with the Proposed Action and MCAPW-DFT, MCAP, and MCAPW Alternatives

Feature To Be Crossed	Pipeline Segment	Crossing Method
Sixth Water Creek[a]	Tanner Ridge Tunnel Inlet	Open trench
Upper Diamond Fork Creek[a]	Diamond Fork Siphon	Open trench
Red Hollow Creek[a]	Red Hollow Pipeline	Open trench
Highway 6	Snell Canyon Pipeline	Tunneling
Denver and Rio Grande Western Railroad	Snell Canyon Pipeline	Tunneling
Utah Railroad	Snell Canyon Pipeline	Tunneling
Spanish Fork River	Snell Canyon Pipeline	Tunneling
SVP Power Canal	Snell Canyon Pipeline	Open trench
Payson Canyon Road	Payson Pipeline	Open trench
Peteetneet Creek	Payson Pipeline	Open trench
Summit Creek	Santaquin Pipeline	Open trench
North Creek	Mona Pipeline	Open trench
Mona Creek	Mona Pipeline	Open trench
I-15 at Mona	Mona Pipeline	Boring and jacking
Willow Creek	Juab Pipeline	Open trench
State Route 41	Nephi Pipeline	Open trench
I-15 at south edge of Nephi	Nephi Pipeline	Boring and jacking
Union Pacific Railroad	Nephi Pipeline	Boring and jacking
State Route 132	Nephi Pipeline	Open trench
Salt Creek	Nephi Pipeline	Open trench
High Line Canal[b]	Salem Bench Pipeline	Open trench

[a]This crossing occurs only in the Proposed Action and MCAPW-DFT Alternative.
[b]This crossing occurs only in the MCAPW-DFT and MCAPW Alternatives.

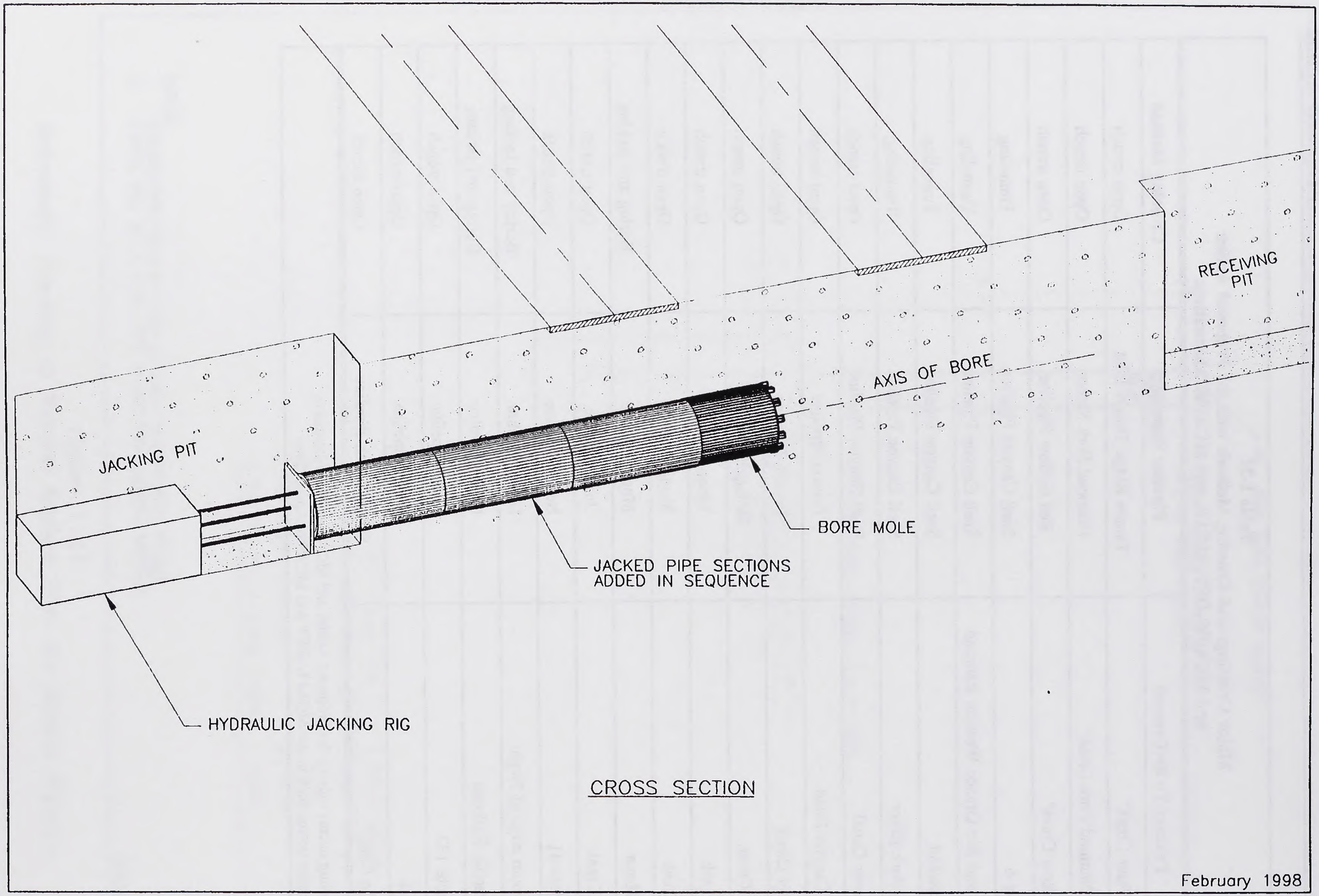


Figure 1-16
Schematic Drawing of a Jacked-Pipe Crossing of a Highway or Railroad

The method for crossing underground utilities would vary, depending on size, depth of burial, and sensitivity to disturbance. Small lines, such as cables, would be supported during the trenching operation and as the pipe is placed under them. For larger and more sensitive lines, the utility companies would be given an opportunity to lower the lines to below the elevation of the pipeline trench to avoid construction interference or risk of disturbance during construction.

1.6.2.10.6 River, Stream, and Canal Crossings. River crossing methods would vary according to specific river characteristics such as width, depth, flow, and riverbed geology. For the Proposed Action, the following river and stream crossings have been identified: Sixth Water Creek, Diamond Fork Creek, Spanish Fork River, Peteetneet Creek, Summit Creek, North Creek, Mona Creek, Willow Creek, and Salt Creek. In addition, some sections of the Main Conveyance Aqueduct would be constructed in the High Line Canal right-of-way. The locations of these crossings are shown on Maps 1-3 and 1-4. The open trench method would be used for all stream and canal crossings.

Trench excavation would likely occur in the non-irrigation season when the Spanish Fork River has its lowest flows. A cofferdam would be constructed approximately 50 to 100 feet upstream of the proposed river crossing. The cofferdam would divert river water to a temporary pipeline or channel, which would carry the water around the trench excavation area. Trenches would likely be excavated by backhoe, and the excavated material would be placed on the river banks above the average high water mark. A minimum burial depth of 6 to 8 feet would be used unless a scour analysis indicates the potential depth of scour could exceed this depth. After installation, the trench would be backfilled, stabilized, and restored to approximate pre-construction contours. The cofferdam would then be removed. The open trench method would also be used to cross the creeks identified above.

If temporary vehicle crossings are needed at any of the river or creek crossings, they would consist of clean rock fill with culverts or temporary bridges. Construction activities in the High Line Canal right-of-way would occur during the non-irrigation season to avoid interruption of water delivery. Pipeline construction along the High Line Canal would not differ substantially from construction in other areas, as shown in Figure 1-17. The trench excavated for the pipeline along the High Line Canal would be larger than the canal cross section. If the pipeline centerline coincides with the High Line Canal centerline, the canal would be completely removed during excavation. In areas where the trench and the canal do not completely overlap, the canal would be filled with spoil left over from trench excavation. Any concrete lining in the canal would be removed during excavation. In most areas, the concrete lining is thin enough to be broken up and removed by the trench excavator. Jackhammers may be required to remove concrete in some areas. Concrete would be disposed of at a landfill that accepts construction debris.

The pipeline would also cross a few irrigation canals. These open trench crossings would be made after bypassing the irrigation water flow through temporary piping over the trench. Any canals affected would be returned to their original condition following the completion of construction activities.

1.6.2.10.7 Quality Control Procedures. Quality control of pipeline construction would be accomplished through visual inspection and hydrostatic testing. After backfilling and all construction work that may affect the pipe have been completed, the pipeline would be hydrostatically tested by the construction contractor to ensure that the system is capable of operating at the design pressure. Pressure would be developed for hydrotesting through contractor-supplied pumps. Should a leak or break occur, the pipeline would be repaired and retested until the specifications have been met. Test segment lengths would be determined by topography and water availability. Water would be obtained through agreements consistent with federal, State, and local regulations and codes. After testing a segment, the water may be pumped into the next segment for testing. The water would ultimately be disposed in accordance with applicable water quality codes.

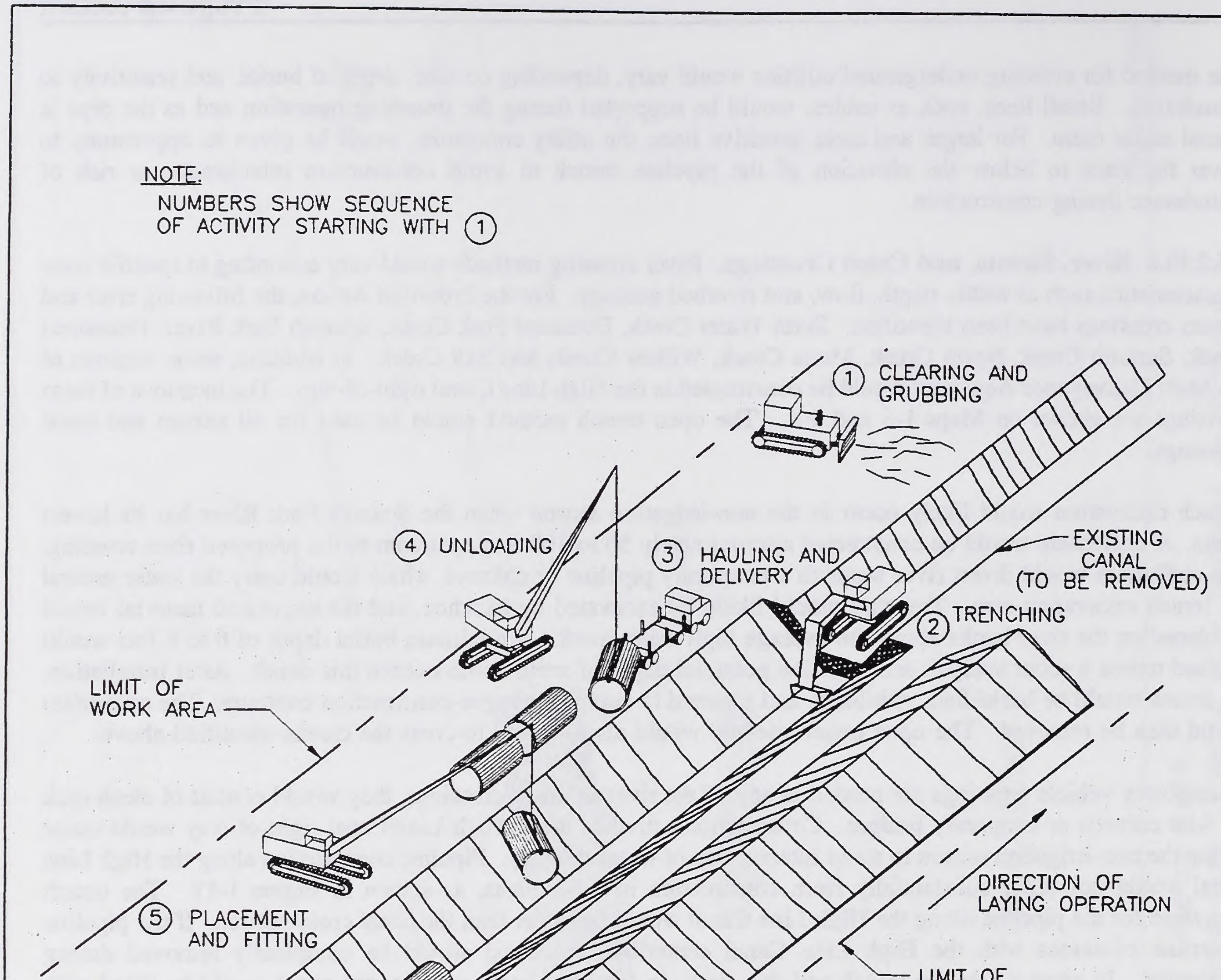


Figure 1-17
Schematic Drawing of Typical Pipeline Construction Procedures Along Existing Canal Alignments

1.6.2.11 Access Roads

Access to the Proposed Action construction sites would involve a combination of existing roads and new roads. Access for the "Diamond Fork Tunnel Alternative" would involve a significant amount of construction, but access to the Main Conveyance Aqueduct and related facilities would be mainly on existing roads.

The Tanner Ridge Tunnel inlet structure site is accessible via an existing unpaved maintenance road from the paved Rays Valley Road on Strawberry Ridge to the outlet of Sixth Water Aqueduct. The maintenance road was constructed to provide access to the Sixth Water Aqueduct outlet and is now used for operation and maintenance access. A one-lane bridge would be constructed across Sixth Water Creek at the construction site to provide construction access and permanent maintenance access to the other side of the creek.

The Tanner Ridge Tunnel outlet, Diamond Fork Siphon, and Red Mountain Tunnel inlet areas are partially accessible by the newly constructed section of Diamond Fork Canyon Road to the end of the Diamond Fork Pipeline (just downstream of Monks Hollow) and then by an older, narrower section of that road. From upper Diamond Fork Canyon Road, two new access roads would be cut into the sidehill terrain on opposite sides of upper Diamond Fork Canyon for access to the Tanner Ridge Tunnel outlet and the Red Mountain Tunnel inlet. The narrow paved road in upper Diamond Fork Canyon would require improvement to increase the load-bearing capacity of the existing bridge across Diamond Fork Creek and may require widening for truck and equipment traffic. This would also be the case for the narrow section of Diamond Fork Canyon Road between Monks Hollow and Three Forks. In its current condition with narrow pavement, curves, and sloping shoulders, the upper Diamond Fork Canyon Road does not provide sufficient space for truck unloading and turnaround. Consequently, construction vehicles would need to be restricted to one-way traffic up Diamond Fork Canyon Road. The return trip to Spanish Fork Canyon would continue up Diamond Fork Canyon Road to Springville Crossing, then easterly along the dirt road to Ray's Valley, and then along Rays Valley Road back to the upper extension of Spanish Fork Canyon. This would require improvement of the dirt road from Springville Crossing to the paved Rays Valley Road.

To minimize the amount of land disturbance, the alignments of the access roads up the hillsides to the tunnels would be chosen through consultation with the USFS. These roads would be used for permanent operation and maintenance access following construction, and future use would be a factor in selecting the final alignments with the USFS. Based on a preliminary assessment, it is estimated that, as a worst case, the new access roads to the Tanner Ridge Tunnel and Red Mountain Tunnel portals in upper Diamond Fork Canyon would be 3,900 feet and 5,000 feet long, respectively. A one-lane bridge would be constructed across Diamond Fork Creek upstream of the existing bridge for the access road to Red Mountain Tunnel.

Construction access to the Red Hollow Pipeline and the Red Mountain Tunnel outlet would involve the use of the first 2.5 miles of the existing unpaved truck road along Red Hollow from its confluence with Diamond Fork Creek. The first 0.75 mile of this road is notched into the west side of a narrow "V"-notch section of the hollow, and the remainder continues up the east side of the hollow through a wider section of the hollow. The existing road would be widened only as necessary to truck in the tunnel boring machine, other construction equipment, tunnel construction materials, and sections of pipe for the Red Hollow Pipeline.

From the existing Red Hollow Road, a branching 1,600-foot-long road would be constructed eastward to provide access to the Red Mountain Tunnel outlet portal and, after completion of construction, converted to a permanent operation and maintenance road. A second branching access road, 8,000 feet long, would be constructed westward from the existing road, over the saddle and onto the bench area that would be traversed by the downstream portion of the Red Hollow Pipeline. This access road would be routed along the alignment of the proposed pipeline as much as possible and would be a temporary road.

Construction activity for the Tanner Ridge and Red Mountain Tunnels and the Diamond Fork Siphon would require the daily closure of Diamond Fork Canyon Road from Monks Hollow to 0.5 mile upstream of the Diamond Fork Siphon, a distance of about 5.5 miles, for a period of about 3 years. Vehicular access would be permitted for a few hours daily to accommodate recreation and stock management travel.

Existing roads would be used if the right-of-way for the Main Conveyance Aqueduct closely parallels an existing utility corridor or if existing roads provide adequate access to the pipeline. Otherwise, temporary access roads from existing roads to the construction sites would be necessary. Temporary roads would have an average width of 25 feet and would be less than 0.25 mile long. There would be fewer than one access road per 5 miles of pipeline.

Temporary roads would average 25 feet in width except where terrain or environmental considerations would limit them to the width needed for equipment passage. Whenever possible, access roads would cross streams and washes at right angles. Culverts would be installed where necessary. Road construction would include dust control measures (e.g., road watering) where necessary. Traffic on new access roads would be restricted to construction traffic unless required by adjacent landowners for private property access. Areas used for temporary access roads would be graded as closely as possible to pre-construction conditions. Existing roads used for construction access would be left in a condition equal to or better than their pre-construction condition.

1.6.2.12 Construction Staging Areas

Construction staging areas would be needed to provide parking space for vehicles and equipment, storage for construction material and fuel, space for equipment maintenance, and reporting locations for workers. The "Diamond Fork Tunnel Alternative" would require six contractor staging areas. A 6-acre staging area for construction of the Diamond Fork Siphon would be created along Diamond Fork Creek about 0.6 mile upstream of Monks Hollow. The other five staging areas, ranging from 1 to 4 acres, would be located at the inlets and outlets of Tanner Ridge and Red Mountain Tunnels and along the Red Hollow Pipeline.

The Main Conveyance Aqueduct would require eight temporary construction staging areas, one for each construction contract; however, their exact locations have not been determined. Each construction yard would be approximately 6 acres in size and would be fenced and the gates locked. Security guards would be stationed where needed. Some minor grading may be needed within the staging areas to accommodate contractor equipment and vehicles, materials, office, and fueling areas.

Construction contractors would be required to submit plans that clearly establish a minimal impact. The plans submitted and the sites selected would be evaluated for consistency with this DEIS. Each staging area would be restored (e.g., graded and revegetated) following construction.

1.6.2.13 Erosion Control and Revegetation

The construction of the "Diamond Fork Tunnel Alternative" would be followed by extensive restoration of the construction area. A restoration plan would be developed for the entire length of surface construction with the USFS. Riparian land along Diamond Fork Creek affected by construction of the Diamond Fork Siphon would be restored with new vegetation to the degree permitted by operation and maintenance of the siphon (no large trees). Restoration of the Main Conveyance Aqueduct right-of-way surface would involve smoothing with motor graders or other equipment and stabilizing slopes where necessary using sandbags, rock riprap, or other materials. On cultivated or improved lands, measures would be taken to relieve compaction, remove rocks, and restore the ground surface in a satisfactory condition. After grading disturbed areas, the construction area would be mulched and reseeded as required. Erosion control and revegetation of the areas impacted by construction activities would be completed as outlined in the *Erosion Control, Revegetation, and Maintenance Plan* (see Appendix A).

1.6.2.14 Maintenance

The "Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct would be built to current standards and require minimal maintenance. Minor repairs would include correction of erosion, repairs to erosion control structures, replacement of pipeline marker posts, and removal of debris from the right-of-way. Other repairs could require reducing pipeline pressure and some excavation, with limited service interruption. Pipeline damage needing major repairs could require extended interruption of water deliveries. Periodic inspections of all SFN System facilities would be conducted to determine necessary maintenance. The CUWCD would maintain the SFN System.

1.6.2.15 Construction Schedule, Work Force, Equipment, Materials, and Costs

After the necessary approvals and federal funding have been obtained, construction of the Proposed Action is projected to take a period of 9 years, including a 3.5-year construction period for the "Diamond Fork Tunnel Alternative." A pipeline segment construction summary is shown in Table 1-22 and a proposed construction schedule for the entire Proposed Action is shown in Figure 1-18. This schedule is based on the assumption that a Record of Decision would be signed in the fall of 1999 and construction would begin in the fall of 1999. The projections are subject to change as the construction program and schedule are refined.

Table 1-22
Construction Summary for the Proposed Action

Pipeline Segment	Segment Length (miles)	Average Production (feet/day)	Construction Duration (# work days)	Construction Schedule	Average Personnel (persons/month)
"Diamond Fork Tunnel Alternative"					
Tanner Ridge Tunnel	1.0	20	282	September 1999 to October 2000	20 to 30
Diamond Fork Siphon	1.4	53	152	March 2002 to October 2002	20 to 30
Red Mountain Tunnel	1.7	25	391	August 2000 to February 2002	20 to 30
Red Hollow Pipeline	2.0	65	174	March 2003 to November 2003	20 to 30
Main Conveyance Aqueduct and Associated Features					
Spanish Fork Pipeline	3.8	82	250	October 1999 to September 2000	20 to 30
Snell Canyon Pipeline	3.5	92	200	November 2000 to August 2001	20 to 30
Salem Bench Pipeline	5.8	122	250	January 2002 to January 2003	20 to 30
Payson Pipeline	4.6	96	250	February 2003 to February 2004	20 to 30
Santaquin Pipeline	6.2	148	220	March 2004 to January 2005	20 to 30
Mona Pipeline	7.1	151	250	April 2005 to April 2006	20 to 30
Juab Pipeline	4.4	115	200	July 2006 to May 2007	20 to 30
Nephi Pipeline*	8.2	172	250	August 2007 to August 2008	40 to 60
Recreation Trail	NA	NA	100	Concurrent with Payson Pipeline Schedule	3 to 5
Total	**43.6**				

*Includes West Mona Pumping Plant and related facilities.

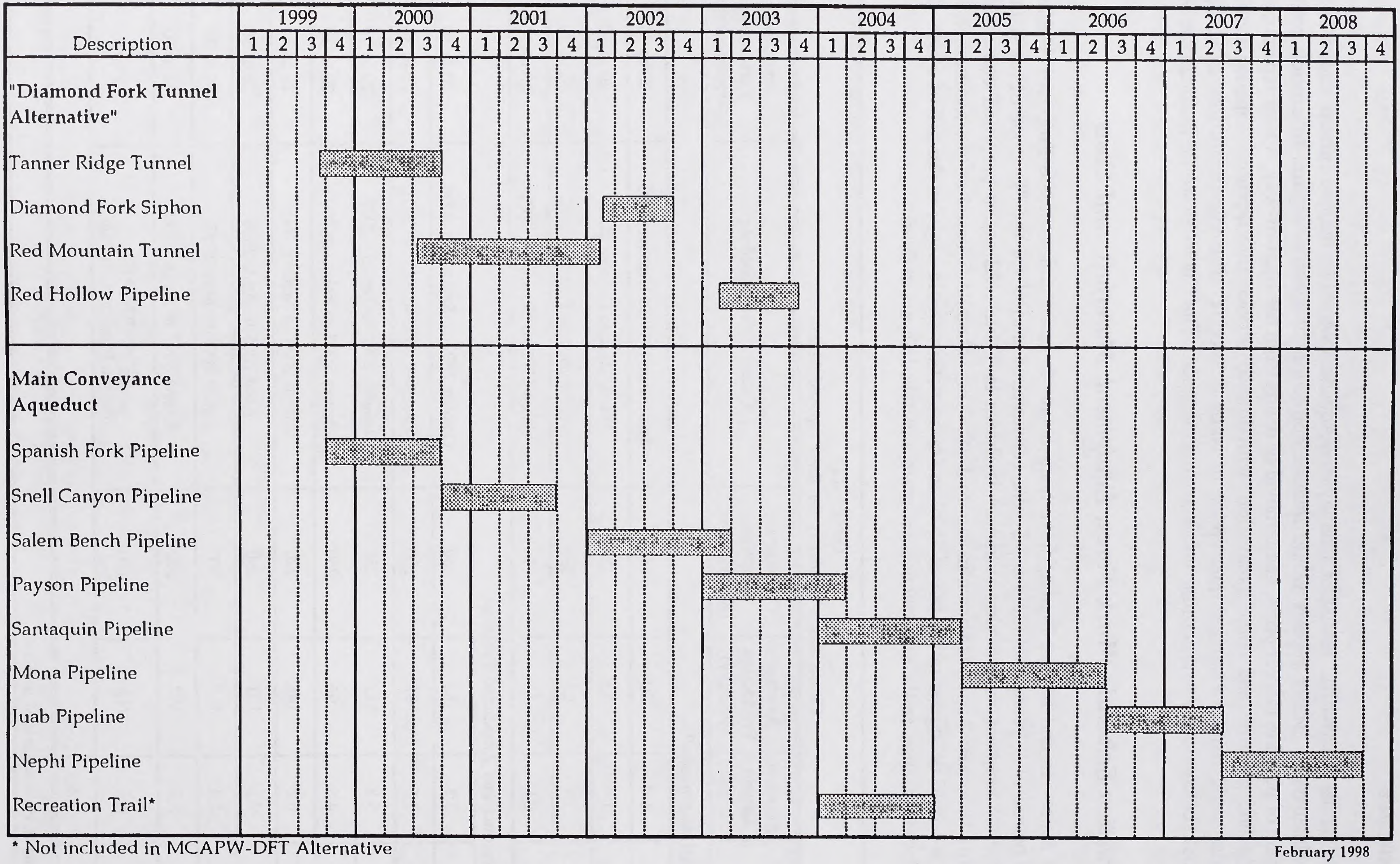


Figure 1-18
Construction Schedule for Proposed Action and MCAPW-DFT Alternative

The average number of construction personnel required per month for each pipeline segment is also shown in Table 1-22. Typical equipment required for the construction of the Proposed Action is shown in Table 1-19, and a list of construction material requirements is provided in Table 1-23. Concrete for tunnel lining, the "Diamond Fork Tunnel Alternative," and the Main Conveyance Aqueduct's Spanish Fork Pipeline would be batched along the Spanish Fork River and trucked to each construction site. Concrete for the remainder of the Main Conveyance Aqueduct and related facilities would be obtained from commercial concrete plants in Utah and Juab Valleys. Gravel for pipe backfill would be imported from commercial sources in Utah County. Construction costs for the Proposed Action are estimated to be approximately $312 million.

Table 1-23
Construction Material Requirements for the Proposed Action

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Tunnel Lining	32,000
	Pipe Lining, Coating, and Bedding	4,000
	Pipeline Structures	6,000
	Pumping Plant	500
	Equalization Reservoirs	6,000
	Turnout Ponds	300
	Total	**89,800**
Steel (lbs)	Concrete Reinforcing	6,470,000
	Pipe Cylinder	161,000,000
	Pumps and Motors	43,000
	Turnout Valves	260,000
	Total	**163,773,000**

1.6.3 MCAPW-DFT Alternative

The MCAPW-DFT Alternative would include the construction, operation, and maintenance of 1) the "Diamond Fork Tunnel Alternative," a 6.1-mile aqueduct in the Diamond Fork drainage to convey water from the existing Syar Tunnel to Sixth Water Aqueduct to the Diamond Fork Pipeline and 2) the 43.5-mile Main Conveyance Aqueduct and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) to deliver Bonneville Unit irrigation water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties and to convey water for delivery to Utah Lake for exchanges with Jordanelle Reservoir and Utah Valley groundwater used for M&I purposes. The "Diamond Fork Tunnel Alternative" is shown on Map 1-3, and the MCAPW-DFT Alternative Main Conveyance Aqueduct is shown on Map 1-7.

The physical facilities of the MCAPW-DFT Alternative would be nearly the same as those of the Proposed Action. In the MCAPW-DFT Alternative, however, the Main Conveyance Aqueduct would not replace the High Line Canal, but would parallel the High Line Canal in the Salem and Payson areas. Operationally, the MCAPW-DFT Alternative would differ from the Proposed Action in that the Main Conveyance Aqueduct would not convey SVP water. The SVP water would be released from the Diamond Fork Pipeline terminus to the Spanish Fork River, which would convey SVP water to the Spanish Fork area for diversion at existing diversion facilities. The

MCAPW-DFT Alternative would provide Bonneville Unit irrigation water to the same agricultural lands as the Proposed Action.

1.6.3.1 Operation of the MCAPW-DFT Alternative

Operation of the MCAPW-DFT Alternative would be similar to the Proposed Action except that 1) the SVP water from Strawberry Reservoir would be conveyed to the Spanish Fork area entirely in the Spanish Fork River instead of partially in the SFN System's Main Conveyance Aqueduct and 2) the High Line Canal would continue to be used to distribute the SVP Water.

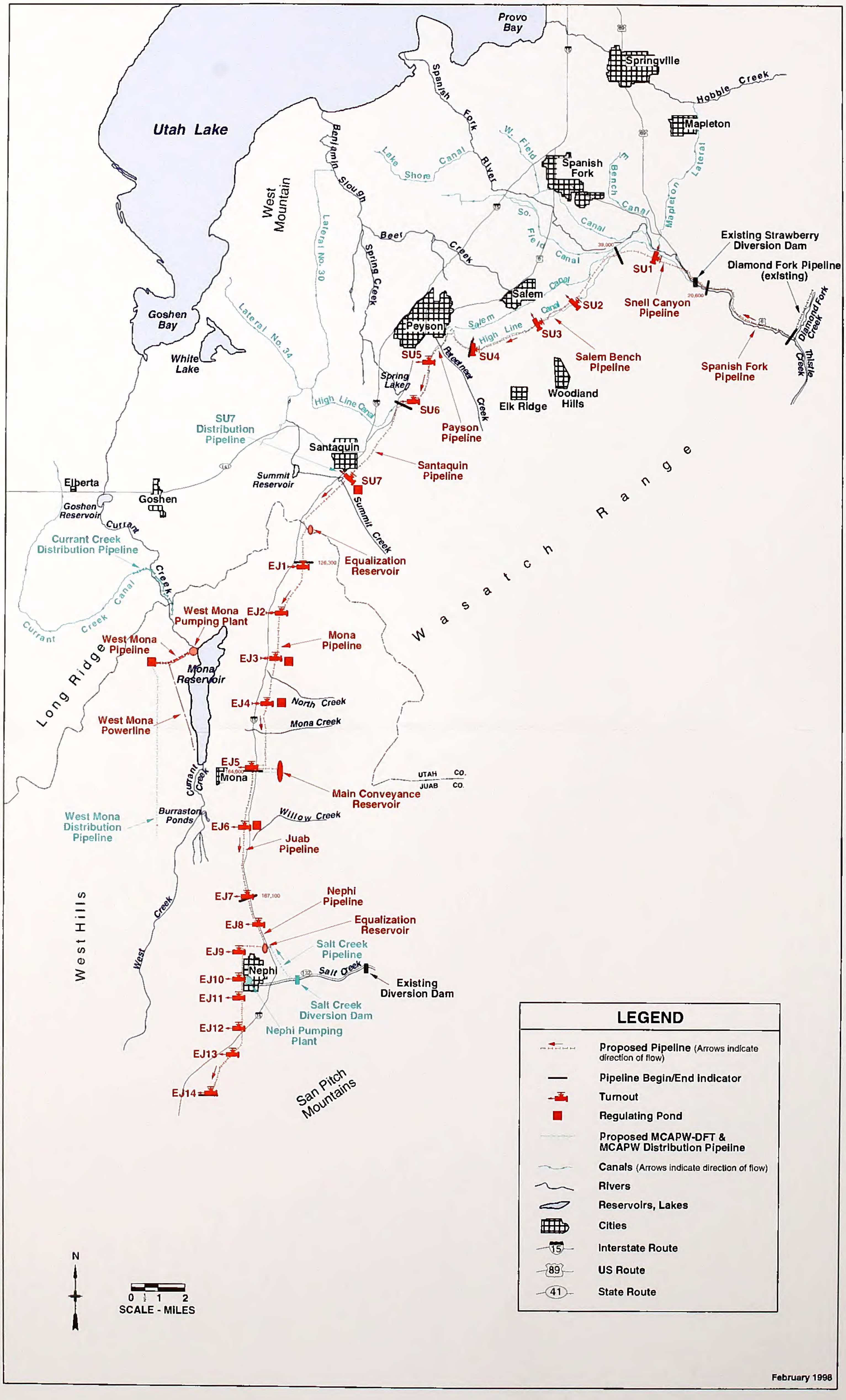
1.6.3.1.1 Transbasin Diversion. The transbasin diversion from Strawberry Reservoir and the conveyance of water from Syar and Strawberry Tunnels to the confluence of Diamond Fork Creek and the Spanish Fork River (where the Diamond Fork Pipeline ends) would be the same as described for the Proposed Action. However, at the Diamond Fork Pipeline terminus, SVP water conveyed in the Diamond Fork Pipeline would be released to the Spanish Fork River for conveyance to the Spanish Fork area, where it would be diverted at the existing Strawberry Diversion Dam. The water conveyed in the Diamond Fork Pipeline and Diamond Fork Creek would be the same as for the Proposed Action, consisting of the following:

• SVP water from Strawberry Reservoir	61,500 acre-feet
• Bonneville Unit water from Strawberry Reservoir	101,900 acre-feet
• Natural flow of Diamond Fork Creek and tunnel seepage	24,500 acre-feet
	187,900 acre-feet

1.6.3.1.2 Water Delivery. The amounts of Bonneville Unit and SVP water delivered under the MCAPW-DFT Alternative, including return flows, are the same as those shown for the Proposed Action in Table 1-7. However, the means of delivering the water would differ somewhat from the Proposed Action. The Main Conveyance Aqueduct flow would be less than in the Proposed Action because SVP water would not be conveyed in the Main Conveyance Aqueduct. The SVP water in the Diamond Fork Pipeline would be conveyed to the Spanish Fork area via the Spanish Fork River; thus, flows in the river would be greater than under the Proposed Action. Bonneville Unit M&I water would be provided through a groundwater exchange involving delivery of replacement water to Utah Lake as described in the Proposed Action.

In the MCAPW-DFT Alternative, an average of 128,300 acre-feet would be released to the existing Diamond Fork Pipeline and 59,600 acre-feet would be released to Diamond Fork Creek; at the end of the Diamond Fork Pipeline, about 68,400 acre-feet would be released from the pipeline to the Spanish Fork River and 59,900 acre-feet would continue into the Main Conveyance Aqueduct. The water released to the Spanish Fork River from the pipeline plus the water in Diamond Fork Creek and the Spanish Fork River upstream of Diamond Fork Creek would produce a combined Spanish Fork River flow averaging approximately 199,200 acre-feet per year.

The 59,900 acre-feet of water conveyed in the Main Conveyance Aqueduct would consist of approximately 6,000 acre-feet of irrigation water for the Santaquin area, 40,700 acre-feet of irrigation water for eastern Juab County (including 4,400 acre-feet delivered to Mona Reservoir), and 13,200 acre-feet of irrigation water for the Spanish Fork area. The 199,200 acre-feet of water conveyed in the Spanish Fork River would consist of 61,500 acre-feet of SVP water, 8,500 acre-feet of Bonneville Unit irrigation water for delivery in the Spanish Fork area, 33,500 acre-feet from Strawberry Reservoir to Utah Lake, 24,500 acre-feet of tunnel seepage and Diamond Fork Creek flow, and 71,200 acre-feet of lower Diamond Fork Creek "gain" from springs and brooks and from Spanish Fork River flow from upstream of Diamond Fork Creek. Strawberry Reservoir water delivered to Utah Lake would consist of 22,300 acre-feet for exchange with Jordanelle Reservoir and 11,200 acre-feet of M&I water for exchange with groundwater.



Map 1-7
Main Conveyance Aqueduct Under the
MCAPW-DFT and MCAPW Alternative

As in the Proposed Action, Mona Reservoir would receive an average of 11,900 acre-feet of additional return flow which, after the loss of 200 acre-feet through evaporation, would provide 11,700 acre-feet of useable return flow for irrigation in the west Mona and Elberta areas and delivery to Utah Lake. The Bonneville Unit water delivered by the Main Conveyance Aqueduct would also be coordinated with local water supplies as described under the Proposed Action. Also, as in the Proposed Action, the 11,200 acre-feet of M&I water for southern Utah County would be developed by exchange with the cities by pumping from wells and springs, or a portion could be delivered directly to secondary water systems developed by the cities.

1.6.3.1.3 Streamflows. Under the MCAPW-DFT Alternative, flows in Sixth Water and Diamond Fork Creeks would be the same as in the Proposed Action. As described for the Proposed Action, the Mitigation Commission may propose to alter the streamflows to enhance aquatic and riparian habitat.

Upper Spanish Fork River flows under the MCAPW-DFT Alternative would consist of the natural flow of the river, lower Diamond Fork Creek flows, and SVP water released from the Diamond Fork Pipeline at the confluence of Diamond Fork Creek with the Spanish Fork River. The projected flows of the upper Spanish Fork River under the operation of the MCAPW-DFT Alternative are shown in Table 1-24. The flows would consist of Strawberry Reservoir water conveyed in Diamond Fork Creek and the natural flows of Diamond Fork Creek and the Spanish Fork River. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-24
Streamflows in the Upper Spanish Fork River Resulting from the MCAPW-DFT Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	177	146	146	146	163	189	285	519	481	466	347	229
acre-feet	10,870	8,680	8,950	8,960	9,060	11,600	16,930	31,880	28,630	28,670	21,340	13,610
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	136	126	123	124	134	139	101	241	377	340	205	202
Wet Year[c]	186	141	140	152	165	181	1,079	1,913	718	540	374	344
Lowest and highest monthly average flows (cfs)												
Lowest[d]	119	123	121	124	129	133	101	231	264	248	168	131
Highest[d]	313	192	195	205	214	282	1,079	1,913	737	576	721	409

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.3.1.4 Operating Entity. The CUWCD would operate and maintain the facilities of the MCAPW-DFT Alternative under operating agreements as described for the Proposed Action, with the following differences. The 1998 operating contract with SWUA would not include conveyance of SVP water in the Main Conveyance

Aqueduct, and contracts would be required with individual irrigation companies in the Spanish Fork area to cover delivery of Bonneville Unit water to their systems. A contract would also be needed with the Strawberry High Line Canal Company to provide for conveyance of Bonneville Unit water in the High Line Canal right-of-way.

1.6.3.2 "Diamond Fork Tunnel Alternative"

Under the MCAPW-DFT Alternative, the "Diamond Fork Tunnel Alternative" would be the same as in the Proposed Action.

1.6.3.3 Main Conveyance Aqueduct

The Main Conveyance Aqueduct in the MCAPW-DFT Alternative would be similar to that of the Proposed Action except for the capacities and diameters of the Spanish Fork and Snell Canyon Pipelines and the alignments of the Salem Bench and Payson Pipelines, which are described below. The length, diameter, and flow capacity of each pipeline segment in the MCAPW-DFT Alternative are shown in Table 1-25.

1.6.3.3.1 Spanish Fork Pipeline. The alignment of the Spanish Fork Pipeline would be the same as described under the Proposed Action. The pipe diameter, however, would be 96 inches and its capacity would be 300 cfs.

1.6.3.3.2 Snell Canyon Pipeline. The Snell Canyon Pipeline would begin and end at the same locations described for the Proposed Action. Upstream from Turnout SU1, the pipeline would be 96 inches in diameter and have a capacity of 300 cfs. Downstream from Turnout SU1, the pipeline would be 96 inches in diameter and have a capacity of 260 cfs.

1.6.3.3.3 Salem Bench Pipeline. The Salem Bench Pipeline would begin at distance marker 39,000 within the existing High Line Canal right-of-way. It would cross under the High Line Canal, proceed to the level of the agricultural lands downslope from the canal, and continue in a southwesterly direction on the west side of the canal at a distance of 150 to 1,600 feet from the canal. For approximately 0.75 mile, the alignment would lie along the eastern edge of the agricultural lands, after which it would proceed across various tracts of agricultural lands to Woodland Hills Road, where it would turn east and cross the canal. From there, the pipeline would run directly along the east side of the High Line Canal to Turnout SU4, approximately 0.5 mile north of Goosenest Road. This pipeline segment would be 5.6 miles long and have a capacity of decreasing from 260 to 225 cfs. This pipeline would not replace any part of the High Line Canal.

1.6.3.3.4 Payson Pipeline. The Payson Pipeline would begin on the south side of the High Line Canal at Turnout SU4 and would run along the canal for approximately 1.0 mile. On the north side of Rocky Ridge, the pipeline alignment would turn away from the canal, cross over the top of Rocky Ridge, and then cross the canal at Peteetneet Creek. From Peteetneet Creek, the pipeline alignment would run along the west side of the canal for about 1.5 miles, then cross the canal and traverse the sloping terrain east (upslope) of community development in the Spring Lakes area to its end at Turnout SU6. The Payson Pipeline would be 4.7 miles long and have a diameter of 84 inches and a capacity of 225 cfs. This pipeline would not replace any part of the High Line Canal.

1.6.3.3.5 Santaquin, Mona, Juab, and Nephi Pipelines. The Santaquin, Mona, Juab, and Nephi Pipelines would have the same lengths and capacities as those described under the Proposed Action.

Table 1-25
MCAPW-DFT Alternative Pipeline Segments

Pipeline Segment Name	Distance Marker (feet)	Length (miles)	Diameter (inches)	Capacity (cfs)
"Diamond Fork Tunnel Alternative"				
Tanner Ridge Tunnel	NA	1.0	114	660
Diamond Fork Siphon	NA	1.5	96	660
Red Mountain Tunnel	NA	1.7	114	660
Red Hollow Pipeline	NA	1.9	96	660
Subtotal		**6.1**		
SFN System				
Spanish Fork Pipeline	300 to 20,600	3.8	96	300
Snell Canyon Pipeline	20,600 to 39,000	3.5	96	300 - 260
Salem Bench Pipeline	39,000 to 68,500	5.6	96	260 - 225
Payson Pipeline	68,500 to 93,300	4.7	84	225
Santaquin Pipeline	93,800[a] to 126,300	6.2	84	225 - 185
Mona Pipeline	126,300 to 164,000	7.1	84	180 - 150
Juab Pipeline	164,000 to 187,100	4.4	84	130 - 115
Nephi Pipeline	187,100 to 230,300	8.2	60 - 30	105 - 20
Subtotal (Main Conveyance Aqueduct Length)		**43.5**		
Distribution Pipelines at Turnouts EJ1 to EJ4[b]		2.1	24 - 20	10 - 15
West Mona Pipeline	NA	1.4	33	25
Subtotal (SFN System)		**47.0**		
Total (MCAPW-DFT Alternative)		**53.1**		

[a]Distance marker 93,800 of the Santaquin Pipeline is the same point as distance marker 93,300 of the Payson Pipeline. The reason for this is that the Salem Bench and Payson Pipelines in the MCAPW-DFT Alternative are 500 feet shorter than their combined length in the Proposed Action.
[b]Four distribution lines totaling 2.1 miles would be built with the Mona Pipeline to convey water from Turnouts EJ1 through EJ4 to the west side of I-15. These distribution lines would be between 0.4 and 0.6 mile in length.

1.6.3.4 Turnouts, Regulating Ponds, and Pumping Plant

1.6.3.4.1 Diamond Fork Pipeline Turnout. A turnout would be constructed at the downstream end of the Diamond Fork Pipeline and release SVP water and Bonneville Unit irrigation water for the SVP service area into Diamond Fork Creek. The turnout would be located north (upstream) of the Highway 6 embankment across the mouth of Diamond Fork Creek. The turnout would have an enclosed gate chamber and an 800-foot-long discharge pipeline to convey the released water to Diamond Fork Creek upstream from the Highway 6 embankment. The discharge pipeline outlet would be designed to avoid stream bank erosion on Diamond Fork Creek by the released water.

1.6.3.4.2 Main Conveyance Aqueduct Turnouts, Regulating Ponds, and West Mona Pumping Plant. Under the MCAPW-DFT Alternative, 21 turnouts would be constructed along the Main Conveyance Aqueduct (see Map 1-7). The turnout capacities for the southern Utah County turnouts are shown in Table 1-26. The turnouts in eastern Juab County would have the same capacities as those in the Proposed Action. A typical turnout is shown in Figure 1-5.

Table 1-26
MCAPW-DFT Alternative Turnout Capacities in Utah County

Turnout	Turnout Capacity (cfs)
SU1	70
SU2	25
SU3	5
SU4	30
SU5	70
SU6	60
SU7	60

The same four turnout regulating ponds described under the Proposed Action would be constructed along the Main Conveyance Aqueduct to incorporate Bonneville Unit water with local surface water supplies (see Map 1-7 and Table 1-16). The West Mona Pumping Plant and its associated facilities would also be as described under the Proposed Action.

1.6.3.5 Main Conveyance Reservoir

The Main Conveyance Reservoir would be the same as that described for the Proposed Action.

1.6.3.6 Equalization Reservoirs

The equalization reservoirs would be the same as those described for the Proposed Action.

1.6.3.7 Recreation Trail

A recreation trail would not be built under the MCAPW-DFT Alternative.

1.6.3.8 Pre-Construction Activities

Pre-construction activities would be the same as those described under the Proposed Action. However, the alignments for the Salem Bench and Payson Pipelines, beside the High Line Canal right-of-way, would increase the private acreage used and decrease the amount of federal acreage. The right-of-way easement widths needed for the Main Conveyance Aqueduct under the MCAPW-DFT Alternative are shown in Table 1-27.

Construction of the features of the "Diamond Fork Tunnel Alternative" would require 47 acres of permanent right-of-way and 81 acres of temporary right-of-way, all in the Uinta National Forest. As in the Proposed Action, the use of the land in the Uinta National Forest would be arranged with the USFS under Special Use Permit procedures.

Table 1-27
Main Conveyance Aqueduct Right-of-Way Easement Widths by Distance Marker for the MCAPW-DFT Alternative

Distance Marker		Length (feet)	Width (feet)	
From	To		Temporary Easements[a]	Permanent Easements
300	3,600	3,300	0	50
3,600	4,100	500	0	75
4,100	6,400	2,300	0	50
6,400	6,600	200	0	72
6,600	6,740	140	85	100
6,740	7,920	1,180	100	100
7,920	8,220	300	65	100
8,220	9,030	810	25	100
9,030	9,430	400	65	100
9,430	12,230	2,800	100	100
12,230	12,430	200	70	100
12,430	15,030	2,600	0	50
15,030	16,000	970	0	75
16,000	24,330	8,330	0	50
24,330	24,930	600	0	100
24,930	26,330	1,400	0	50
26,330	26,520	190	0	100
26,520	26,810	290	100	100
26,810	27,270	460	0	50
27,270	200,000	172,230[b]	100	100
200,000	230,300	30,300	60	60

[a]Temporary easement width is in addition to the permanent easement width and is used only during construction. Where temporary easement is shown as zero, it is in the existing Highway 6 right-of-way.
[b]This length is 500 feet shorter than the difference between the distance markers cited, reflecting the shorter length of the Salem Bench and Payson Pipelines on new alignments beside the High Line Canal.

Construction of the Main Conveyance Aqueduct and its associated facilities would require 547 acres of permanent right-of-way of which approximately 89 percent would be on private land and the rest on federal, State, county, and city land. The temporary right-of-way needed for construction of the Main Conveyance Aqueduct and its associated facilities would be approximately 540 acres, of which approximately 93 percent would be private land, with the rest distributed among federal, State, county, and city ownership. The land acquisition procedures would be as described for the Proposed Action.

1.6.3.9 Tunnel Construction Procedures

The tunnel construction procedures for the MCAPW-DFT Alternative would be the same as for the Proposed Action.

1.6.3.10 Pipeline Construction Procedures

The steps required for constructing the MCAPW-DFT Alternative would be the same as those described under the Proposed Action. Major crossings and crossing methods would include all the crossings in the Proposed Action, plus two crossings of the High Line Canal, as shown on Table 1-21. The land disturbance that would result from the MCAPW-DFT Alternative is listed on Table 1-28. An itemization of "Diamond Fork Tunnel Alternative" acreage by facility is presented with the Proposed Action (see Table 1-18).

Table 1-28
Land Disturbance Resulting from the MCAPW-DFT Alternative

Project Feature	Acres Temporarily Disturbed During Construction	Acres to be Revegetated	Acres Permanently Disturbed
"Diamond Fork Tunnel Alternative"			
All facilities	128.0	118.5	9.5
Main Conveyance Aqueduct and Associated Features			
Pipeline and Turnouts	946.1	943.6	2.5
Regulating Ponds	9.8	0.0	9.8
West Mona Pumping Plant	34.3	30.7	3.6
Equalization Reservoirs	6.0	4.0	2.0
Main Conveyance Reservoir*	38.4	3.4	35.0
Access Roads	4.6	4.6	0.0
Construction Staging Areas	48.0	48.0	0.0
Subtotal	**1,087.2**	**1,034.3**	**52.9**
Total Acres	**1,215.2**	**1,152.8**	**62.4**

*Includes 3.4 acres of temporary disturbance for connecting pipeline.

1.6.3.11 Access Roads

The construction access roads needed for the MCAPW-DFT Alternative are the same as those described under the Proposed Action.

1.6.3.12 Construction Staging Areas

Under the MCAPW-DFT Alternative, the construction staging areas would be the same as those described under the Proposed Action.

1.6.3.13 Erosion Control and Site Restoration

Under the MCAPW-DFT Alternative, erosion control activities and revegetation of areas impacted by construction activities would be the same as those described under the Proposed Action.

1.6.3.14 Maintenance

The maintenance of the facilities constructed under the MCAPW-DFT Alternative would be the same as that described for the Proposed Action.

1.6.3.15 Construction Schedule, Work Force, Equipment, Materials, and Costs

The construction schedule for the MCAPW-DFT Alternative would be the same as that described under the Proposed Action. The schedule is shown on Figure 1-19. The equipment and work force are listed in Tables 1-19 and 1-22, respectively. A list of construction material requirements is provided in Table 1-29. The sources of construction materials would be the same as with the Proposed Action. The construction cost of the MCAPW-DFT Alternative would be approximately $281 million, or 90 percent of the cost of the Proposed Action.

Table 1-29
Construction Material Requirements for the MCAPW-DFT Alternative

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Tunnel lining	32,300
	Pipe Lining, coating, and bedding	42,500
	Pipeline structures	6,000
	Pumping plant	500
	Equalization reservoirs	6,000
	Turnout ponds	300
	Total	**87,600**
Steel (lbs)	Concrete reinforcing	6,400,000
	Pipe cylinder	135,000,000
	Pumps and motors	43,000
	Turnout valves	250,000
	Total	**141,693,000**

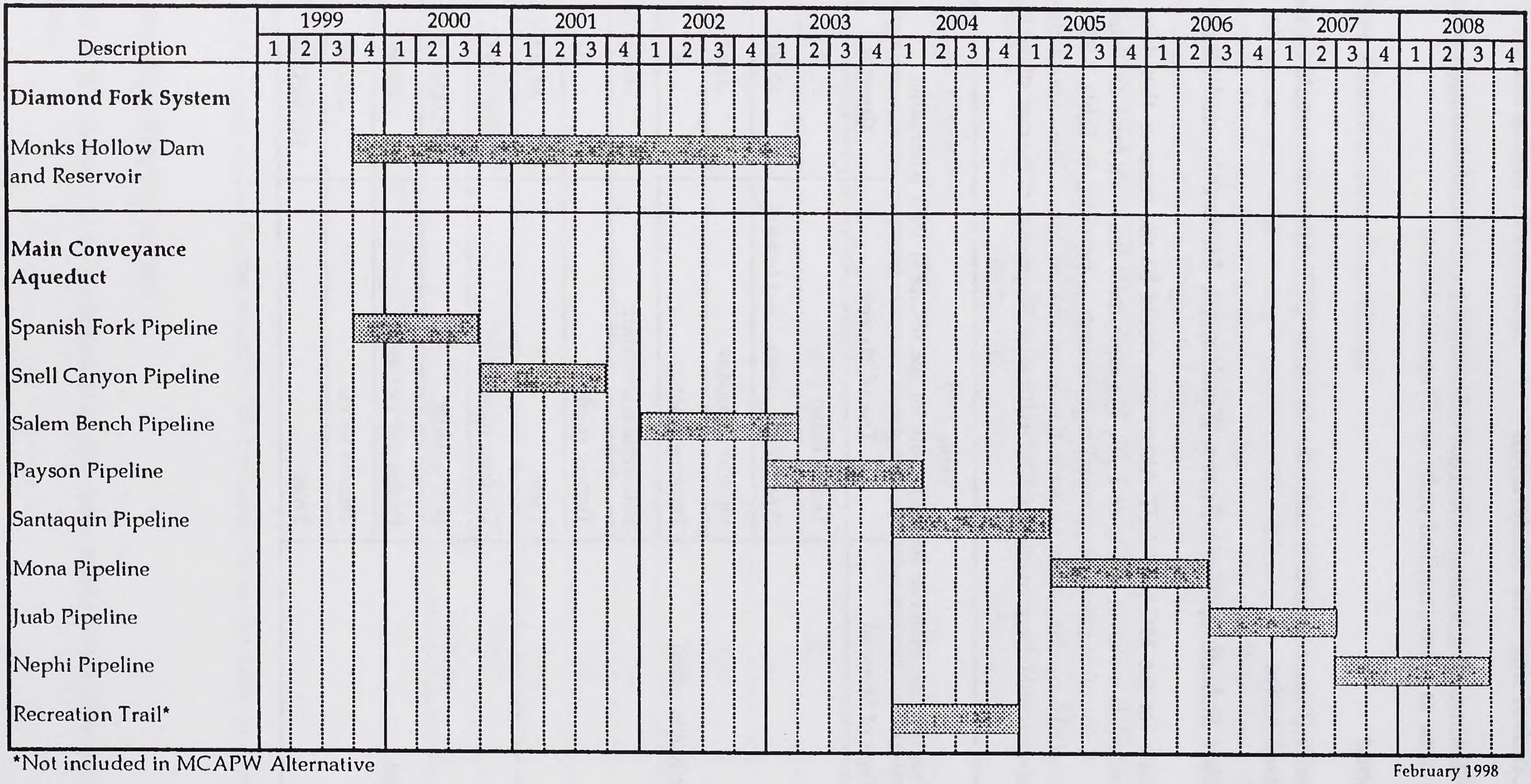


Figure 1-19
Construction Schedule for MCAP and MCAPW Alternatives

1.6.4 MCAP Alternative

The MCAP Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 43.6-mile-long pipeline, and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline (located on the north side of Highway 6 at Diamond Fork Road) to southern Utah and eastern Juab Counties. The location of the Main Conveyance Aqueduct and related facilities under the MCAP Alternative is shown in Map 1-4. The Main Conveyance Aqueduct would deliver irrigation water to the same agricultural lands in southern Utah and eastern Juab Counties and M&I water to southern Utah County in a manner similar to the Proposed Action Main Conveyance Aqueduct.

The MCAP Alternative differs from the Proposed Action in that it would not include construction of the "Diamond Fork Tunnel Alternative." Instead, it would include construction of Monks Hollow Dam and Reservoir in the Diamond Fork drainage. Those features that would be constructed as part of the Diamond Fork System are shown on Map 1-8. These physical differences would change the operation of the Diamond Fork System and produce less flow in the Diamond Fork Pipeline and more flow in Diamond Fork Creek. The M&I water provided for southern Utah County would be delivered directly from the Main Conveyance Aqueduct.

1.6.4.1 Operation of the MCAP Alternative

Operation of the MCAP Alternative is shown in Figure 1-20. The average annual flows shown in Figure 1-20 are only those flows that are a part of the Bonneville Unit and the SVP transbasin diversion; they do not include the natural flows of Diamond Fork Creek or the Spanish Fork River.

1.6.4.1.1 Transbasin Diversion. The average transbasin diversion from Strawberry Reservoir would be approximately 163,400 acre-feet per year, including 101,900 acre-feet of SFN System water and 61,500 acre-feet of SVP water from Strawberry Reservoir. The Syar Tunnel would convey about 146,300 acre-feet per year, and the Strawberry Tunnel would convey about 20,700 acre-feet (including 3,600 acre-feet of tunnel seepage) per year. Both tunnel would discharge to Sixth Water Creek, which would convey the water to Monks Hollow Reservoir. The diversion through Strawberry Tunnel would be limited to the flow needed to maintain the instream flow requirements for Sixth Water Creek as mandated by CUPCA (i.e., not less than 32 cfs from May through October and not less than 25 cfs from November through April). This is a change from the Proposed Action, which would also use Strawberry Tunnel to deliver irrigation water infrequently when summer demand is unusually high. A schematic drawing of the operation of the Diamond Fork System under the MCAP Alternative is shown in Figure 1-21. The flows described above would be subject to the same tunnel maintenance interruptions as described for the Proposed Action.

Monks Hollow Reservoir would regulate the water diverted from Strawberry Reservoir to allow summer water delivery at higher flow rates than the flow rates available through Syar Tunnel. To provide an adequate water supply during the hottest part of the summer, peak releases from Monks Hollow Reservoir would be needed at a rate of 880 cfs. Syar Tunnel would be operated with a maximum flow of 600 cfs under the MCAP Alternative rather than the higher flow under the Proposed Action, limiting the impact on lower Sixth Water Creek. The difference would need to be met from water stored in Monks Hollow Reservoir during non-peak periods. This requirement exists in spite of the reduction in peak period water needs through improvements of irrigation efficiency that would accompany the development of the SFN System and through the rescheduling of irrigation well pumping to maximize groundwater use in the summer, as discussed in Section 1.9. Release of water from Monks Hollow Dam to the Diamond Fork Pipeline and the Main Conveyance Aqueduct would permit delivery of water by gravity flow to Nephi.

The average annual total flow available at Monks Hollow Dam, including natural flows, would be 186,900 acre-feet, after an evaporation loss to Monks Hollow Reservoir of 1,000 acre-feet. Of the 186,900 acre-feet available at Monks Hollow Dam, an average of 127,200 acre-feet would be released into the Diamond Fork Pipeline and

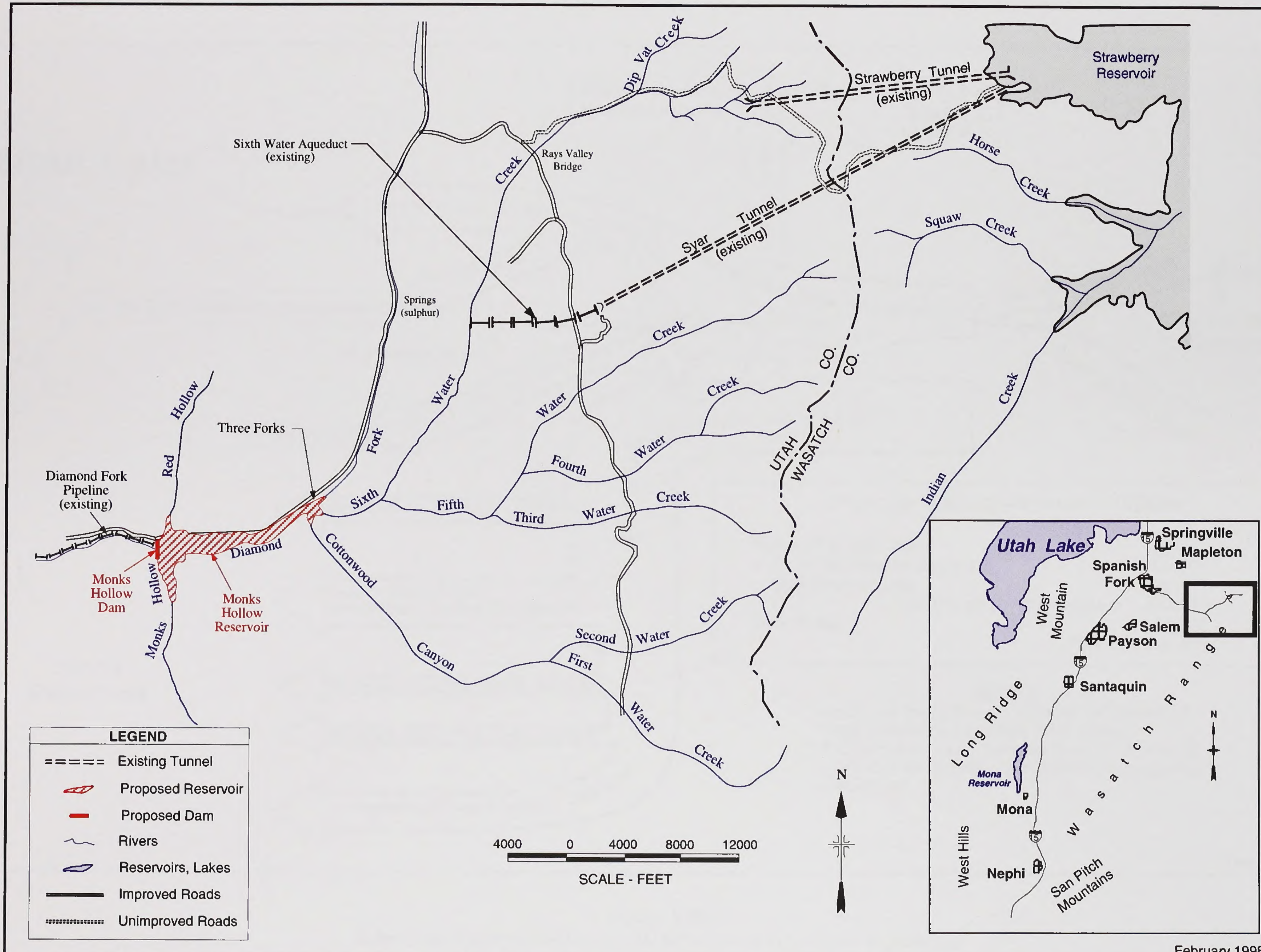
59,700 acre-feet would be released to Diamond Fork Creek. The water released into the Diamond Fork Pipeline would continue into the Main Conveyance Aqueduct for delivery in Utah and Juab Valleys. The water released to Diamond Fork Creek would be used for delivery to diverters from the Spanish Fork River, for streamflow maintenance, and for delivery to Utah Lake. Minimum streamflows in lower Diamond Fork Creek would receive first priority for routing the water and would govern the release of water to the creek at Monks Hollow Dam. The minimum flow of Diamond Fork Creek would be maintained at 80 cfs from May through September and 60 cfs from October through April. The balance of the water needed for irrigation demand or other purposes would flow through the Diamond Fork Pipeline until the pipeline is operating at 510 cfs, its maximum flow rate when connected to Monks Hollow Dam. Any further increase in flow needed for downstream delivery would be released to Diamond Fork Creek at Monks Hollow Dam and conveyed to the Spanish Fork River for diversion at the Strawberry Diversion Dam.

1.6.4.1.2 Water Delivery. Under the MCAP Alternative, 1,000 acre-feet of the 101,900 acre-feet of Bonneville Unit water released from Strawberry Reservoir would be lost to evaporation from Monks Hollow Reservoir. The remaining 100,900 acre-feet would be conveyed to southern Utah and eastern Juab Counties for irrigation, M&I use, and water supply for Utah Lake in the amounts shown on Table 1-30. The irrigation water would be used on the southern Utah and eastern Juab County lands shown on Map 1-2. The M&I water would be used in Southern Utah County, and the Utah Lake water supply would be used for exchange to Jordanelle Reservoir.

Table 1-30
Bonneville Unit and SVP Average Water Deliveries
Under the MCAP, MCAPW, MCATC, and MCAT Alternatives[a] (acre-feet/year)

Purpose	Transbasin Diversion from Strawberry Reservoir	Bonneville Unit Return Flows Available for Reuse	Total
Bonneville Unit Water Supply			
Irrigation Water			
Spanish Fork area	21,700	0	21,700
Santaquin area	6,500	0	6,000
Elberta area	0	3,400*	3,400
Mona area	13,700	0	13,700
West Mona area	4,400	1,300*	5,700
Nephi area	22,600	0	22,600
Subtotal	**68,400**	**4,700**	**73,100**
M&I Water			
Southern Utah County	11,200	0	11,200
Mona-Nephi	36,300	0	36,300
West Mona	4,400	1,300[b]	5,700
Evaporation from Monks Hollow Reservoir	11,200	0	11,200
Utah Lake Water Supply	21,300	20,800	42,100
Subtotal, Bonneville Unit	**101,900**	**25,500**	**127,400**
SVP Water Supply			
Irrigation Water, Spanish Fork area	61,500	0	61,500
Total Delivery	**163,400**	**25,500**	**188,900**

*Deliveries of return flow from Mona Reservoir.



Map 1-8
Diamond Fork Drainage Under the MCAP, MCAPW, MCATC, and MCAT Alternatives

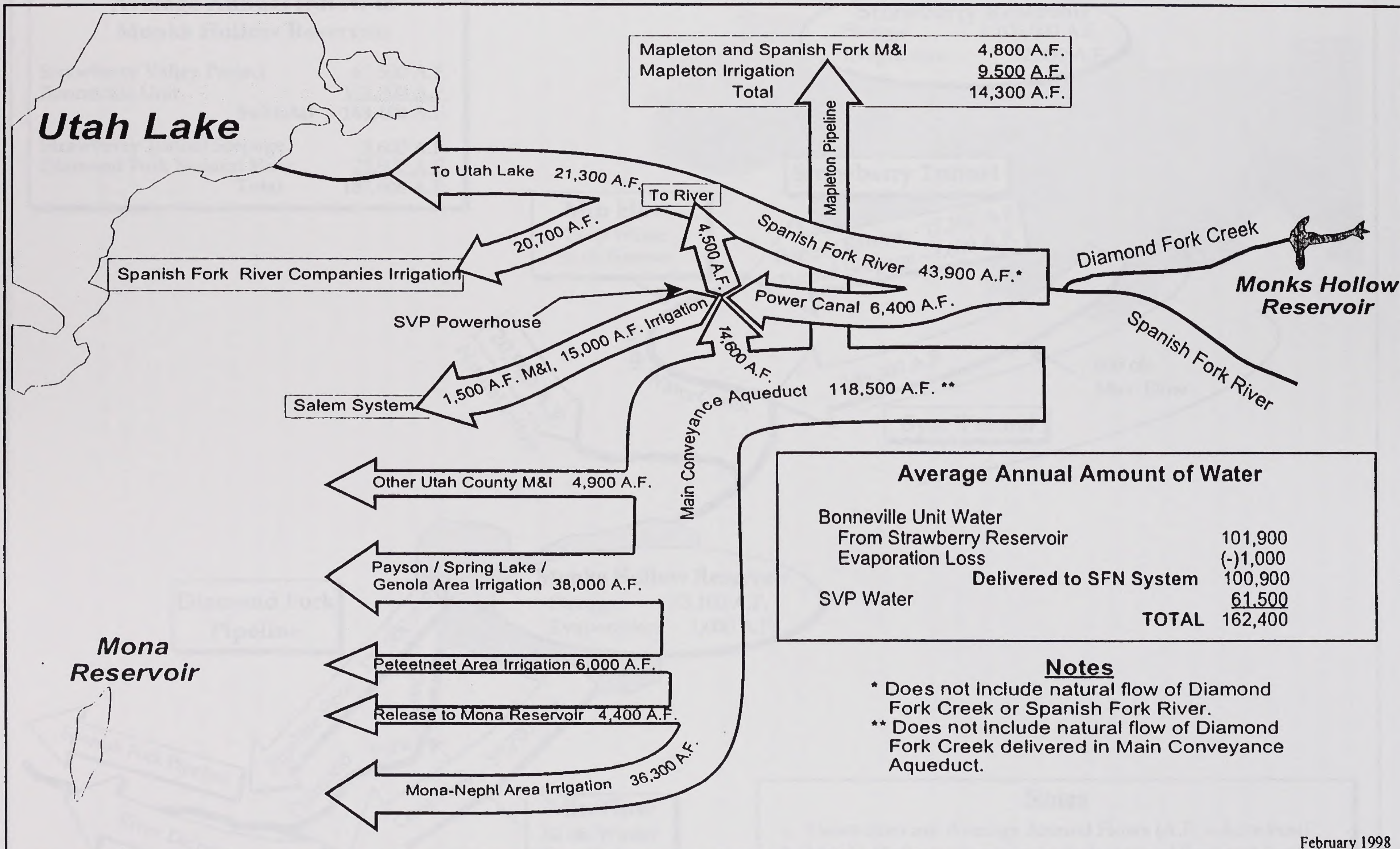


Figure 1-20
Schematic Representation of MCAP Alternative Water Operation

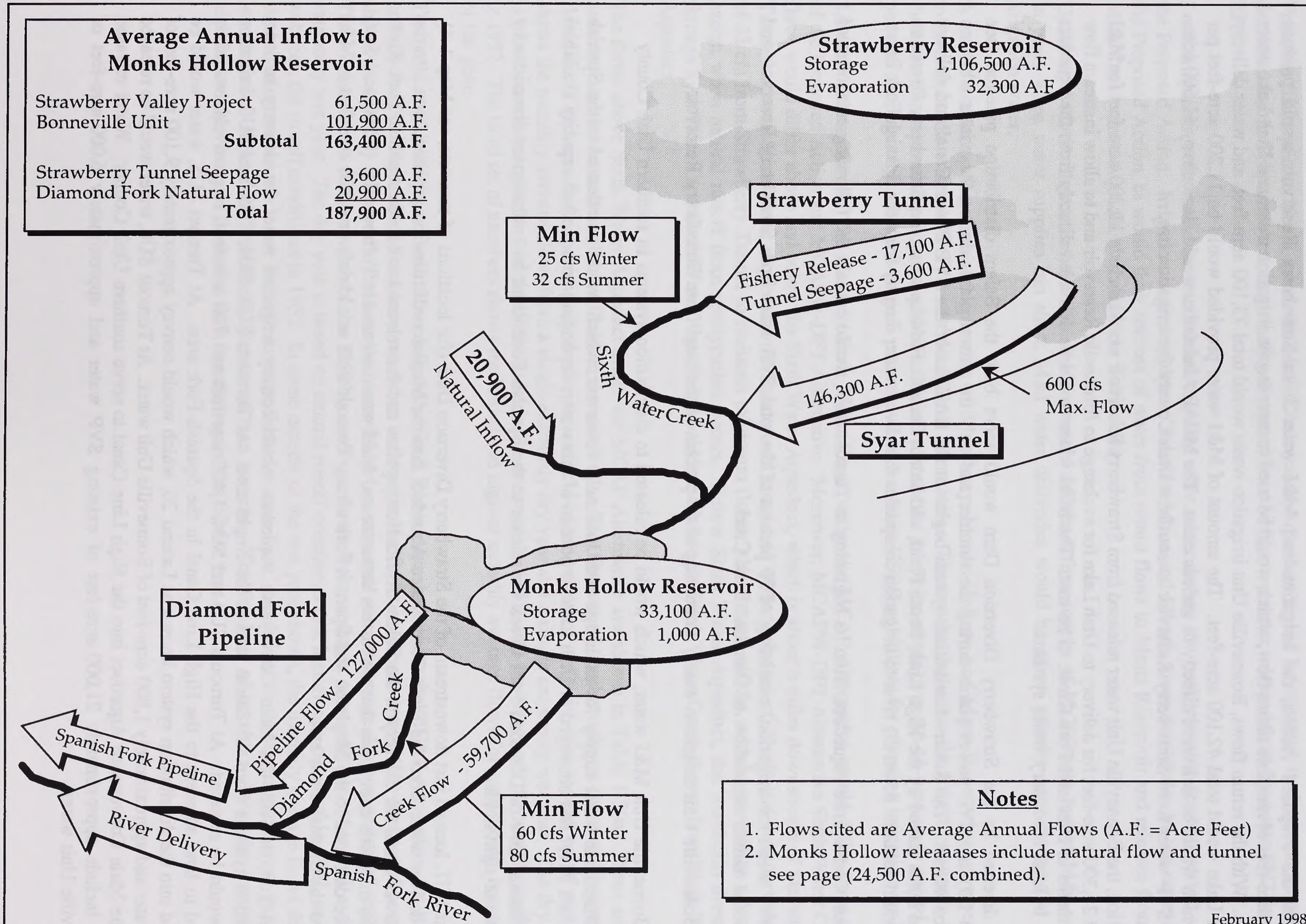


Figure 1-21
Schematic of Diamond Fork System Operation Under the MCAP Alternative

As under the Proposed Action, the irrigation and M&I water from Strawberry Reservoir would produce 25,500 acre-feet of reusable return flow, which would be used to increase the irrigation water and Utah Lake water supplies. With the return flows, Bonneville Unit irrigation water would total 73,100 acre-feet, and water delivery to Utah Lake would total 42,100 acre-feet. The amount of M&I water provided would be 11,200 acre-feet per year, which would be delivered directly to various cities. The MCAP Alternative would also convey 61,500 acre-feet of SVP water from Strawberry Reservoir to southern Utah County for irrigation use.

In addition, the Bonneville Unit water released from Strawberry Reservoir would include 11,200 acre-feet for M&I use and 21,300 acre-feet for delivery to Utah Lake for exchange to Jordanelle Reservoir and to allow instream flow requirements in Diamond Fork Creek to be met. The M&I water would be delivered directly from the aqueduct for use in local secondary water systems.

Water diverted by the Strawberry Diversion Dam would serve both the Salem distribution pipeline (see Section 1.9) and SVP power plants during the summer and only the power plants during the winter when no irrigation occurs. The Salem distribution system begins at the terminus of the SVP Power Canal and delivers water to lands served by the High Line, South Field, and Salem Canals. Flows passing the Strawberry Diversion Dam would continue down the river to irrigation companies that divert water directly from the Spanish Fork River.

The Main Conveyance Aqueduct, from its beginning to Turnout SU7, would contain the following categories of water:

- SVP water for irrigation, consisting of 79 percent of the total SVP water from Strawberry Reservoir and some natural streamflow of Diamond Fork Creek

- Bonneville Unit irrigation water, amounting to 68 percent of the total from Strawberry Reservoir

- Bonneville Unit M&I water, which would be released to distribution systems in southern Utah County

- Utah Lake water supply for exchange with Jordanelle Reservoir, which would be released to the Spanish Fork River and conveyed to Utah Lake (a portion of this water, depending on aqueduct capacity available)

- Natural flow of Diamond Fork Creek for release to the Spanish Fork River and subsequent diversions by water right holders

Turnout SU1, located just downstream of the Strawberry Diversion Dam (for locations of turnouts, see Map 1-4), would deliver water from the Main Conveyance Aqueduct into the Mapleton distribution pipeline, then into the SVP Power Canal for delivery to the Salem distribution pipeline and for release back to the Spanish Fork River for those irrigation companies that are further downstream. M&I water released at Turnout SU1 (6,300 acre-feet) would be delivered to the Mapleton and Spanish Fork areas. Turnout SU2 would deliver 4,900 acre-feet of M&I water to the Spanish Fork area.

Beyond Turnout SU2, the Main Conveyance Aqueduct would convey irrigation water for delivery to local distribution systems from the Salem area to the Nephi area. At Turnouts SU3, SU4, SU5, and SU6, irrigation water would be released. At Turnouts SU3 and SU4, 1,400 acre-feet and 700 acre-feet, respectively, would be released to land adjacent to the High Line Canal in the Spanish Fork area. At Turnout SU5, water would be released into the distribution system known as Lateral 20, which would convey approximately 9,100 acre-feet of SVP water and approximately 1,800 acre-feet of Bonneville Unit water. At Turnout SU6, water would be released from the Main Conveyance Aqueduct into the High Line Canal to serve southern Utah County. Water released would include approximately 21,000 acre-feet of existing SVP water and approximately 6,000 acre-feet of Bonneville Unit water.

From the Santaquin to Nephi areas, the Main Conveyance Aqueduct would be operated in the same manner as described for the Proposed Action, including the quantities of irrigation water released from Turnouts SU7 through EJ14.

Local irrigation wells would be rescheduled to pump more water during the peak summer demand period, as in the Proposed Action. Irrigation water supplies to the west Mona and Elberta areas would also be the same as in the Proposed Action, as would their sources of water from return flows to Mona Reservoir and releases from the Main Conveyance Aqueduct, as shown in Table 1-30.

Under the MCAP Alternative, the SFN System would deliver a firm supply of 11,200 acre-feet of M&I water. In years when water supplies run short, M&I water deliveries would be given priority over Bonneville Unit irrigation water.

A model simulating the combined operation of Strawberry, Monks Hollow, and Mona Reservoirs was operated to investigate the water delivery under the MCAP Alternative. The results show that the irrigation supply from the Main Conveyance Aqueduct would be sufficient to meet the irrigation needs over the 44-year study period with periodic shortages that would average 5 percent, which is within USBR guidelines for planning irrigation projects.

1.6.4.1.3 Streamflows. The flows in Sixth Water Creek under the MCAP Alternative would differ from those of the Proposed Action and MCAPW-DFT Alternative. Moreover, MCAPW-DFT Alternative Sixth Water Creek flows would differ above and below the Sixth Water Aqueduct, which is about 6 miles downstream of Strawberry Tunnel. Above Sixth Water Aqueduct, the flow would consist of winter releases of 25 cfs and summer releases of 32 cfs from Strawberry Tunnel to maintain minimum flows, plus natural inflow, which amounts to a few cfs except when natural runoff from precipitation occurs. Below Sixth Water Aqueduct, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be added to the Sixth Water Creek flows above Sixth Water Aqueduct.

The flows above Sixth Water Aqueduct under the MCAP Alternative are shown in Table 1-30a. Three sets of numbers are shown to describe the flows in various ways. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

The projected Sixth Water Creek flows below the Sixth Water Aqueduct under the MCAP Alternative are shown in Table 1-30b. Three sets of numbers are shown to describe the flows in various ways. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. In some months of the wet year shown, the monthly average flows during the irrigation season are lower than the average flows because "wet" conditions in the agricultural areas required less irrigation water from Strawberry Reservoir than average. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-30a
Streamflows in Sixth Water Creek Above Sixth Water Aqueduct Resulting from the MCAP Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	27	27	27	28	34	49	40	35	34	34
acre-feet	2,100	1,630	1,660	1,650	1,520	1,710	2,040	2,990	2,370	2,130	2,080	2,020
Representative dry year and wet year monthly average flows (cfs)												
Dry year[b]	34	27	27	27	27	27	28	36	32	32	33	34
Wet Year[c]	35	28	28	27	29	28	59	88	53	37	36	35
Lowest and highest monthly average flows (cfs)												
Lowest[d]	32	26	25	26	26	26	26	33	32	32	32	32
Highest[d]	36	30	30	28	29	31	59	88	68	38	38	38

[a]Rounded to nearest whole cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Table 1-30b
Streamflows in Sixth Water Creek Below Sixth Water Aqueduct Resulting from the MCAP Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	124	63	61	61	58	50	78	270	555	632	552	303
acre-feet	7,610	3,720	3,770	3,740	3,240	3,080	4,670	16,610	33,010	38,830	33,930	18,040
Representative dry year and wet year monthly average flows (cfs)												
Dry year[b]	122	64	65	62	67	51	68	334	568	574	316	242
Wet Year[c]	128	59	50	53	53	49	84	214	362	609	425	338
Lowest and highest monthly average flows (cfs)												
Lowest[d]	92	49	40	49	50	32	38	121	362	573	316	194
Highest[d]	186	70	72	70	74	100	197	496	639	639	636	478

[a]Rounded to nearest whole cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

The projected flows in Diamond Fork Creek below Monks Hollow Dam under the MCAP Alternative are shown in Table 1-31. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet

year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. In some months of the wet year shown, the monthly average flows during the irrigation season are lower than the 44-year average monthly flows because "wet" conditions in the agricultural areas required less irrigation water from Strawberry Reservoir than average. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-31
Streamflows in Diamond Fork Creek Below Monks Hollow Resulting from the MCAP Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	60	60	60	60	60	60	60	81	130	194	81	80
acre-feet	3,690	3,570	3,690	3,690	3,360	3,690	3,570	4,990	7,750	11,940	4,980	4,760
Representative dry year and wet year monthly flows (cfs)												
Dry year[b]	60	60	60	60	60	60	60	80	80	80	80	80
Wet Year[c]	60	60	60	60	60	60	60	80	80	122	80	80
Lowest and highest monthly average flows (cfs)												
Lowest[d]	60	60	60	60	60	60	60	80	80	80	80	80
Highest[d]	60	60	60	60	60	60	60	130	357	292	113	80

[a]Flows over 80 cfs are rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Occasional flushing flow releases would be created by routing natural floods above Monks Hollow through the reservoir to Diamond Fork Creek below Monks Hollow. These releases would permit scouring of the floodplain, which would help promote cottonwood (*Populus* spp.) reproduction and help maintain the habitat of Ute ladies'-tresses (*Spiranthes diluvialis*), a protected plant species. The flushing flows to Diamond Fork Creek would be made when natural flooding conditions occur in Diamond Fork Creek upstream from Monks Hollow Reservoir and would be regulated to mimic historical floods on Diamond Fork Creek up to the "10-year flood," which has a peak flow of 790 cfs. Historical flood flows have exceeded 1,000 cfs as evidenced by the 1983 flood that surpassed 3,000 cfs.

The projected flows in the upper Spanish Fork River under the MCAP and MCATC Alternatives are shown in Table 1-32. The flows consist of Strawberry Reservoir water conveyed in Diamond Fork Creek and the natural flows of Diamond Fork Creek and the Spanish Fork River. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

1.6.4.1.4 Operating Entity. CUWCD would operate and maintain the SFN System. SVP water would be delivered in the Main Conveyance Aqueduct under a 1998 operating contract with SWUA, as discussed in Section 1.7. Other operating agreements would also be needed as discussed in Section 1.7.

Table 1-32 Streamflows in the Upper Spanish Fork River Resulting from the MCAP and MCATC Alternatives												
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	115	114	114	114	129	154	239	365	263	264	156	139
acre-feet	7,040	6,755	7,023	7,035	7,136	9,489	14,242	22,436	15,659	16,242	9,573	8,242
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	92	94	91	92	100	106	100	118	99	103	117	115
Wet Year[c]	113	107	107	120	130	149	896	1,580	483	311	219	187
Lowest and highest monthly average flows (cfs)												
Lowest[d]	87	91	90	92	93	98	100	118	99	103	100	105
Highest[d]	163	158	163	172	178	249	896	1,580	491	363	440	305

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.4.1.5 Operational Life. The operational life of the MCAP Alternative would be 75 years, with typical replacement lives of various facilities as shown in Table 1-11.

1.6.4.1.6 Control System. A Supervisory Control and Data Acquisition System (SCADA) would be installed to control and monitor the operation of the MCAP Alternative, as described for the Proposed Action.

1.6.4.1.7 Coordination with Local Water Supplies. The MCAP Alternative would coordinate Bonneville Unit water with local water supplies in the same ways as the Proposed Action.

1.6.4.1.8 Power Requirements. Under the MCAP Alternative, CRSP power would be used to meet the power requirements of the SFN System. Approximately 11,675,000 kilowatt-hours of energy per year would be required to operate the pumping plant and wells after a credit for increased generation at SVP power plants. These power requirements are listed in Table 1-33.

Table 1-33 MCAP Alternative Average Annual Power Requirements		
Purpose/Location	**Peak Capacity (kilowatts)**	**Average Annual Energy (kWh)**
Replacement Power Spanish Fork Power Plants	1,880	-595,000
Pumping Power West Mona Pumping Plant	900	2,500,000
Total Power	**2,780**	**1,905,000**

1.6.4.2 Monks Hollow Dam and Reservoir

As mentioned in the introduction to this section, the MCAP Alternative would include the construction of the Monks Hollow Dam and Reservoir (see Map 1-8), which is a feature of the Diamond Fork System as proposed in Alternative B, Proposed Action, in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990).

The proposed Monks Hollow Dam would be a 258-foot-high, concrete arch structure with a crest length of 925 feet and a crest width of 13 feet. Two separate outlet works would be provided for the dam. One would discharge water through a pressure control structure and then into the Diamond Fork Pipeline. This outlet would have a capacity of 510 cfs. The other would discharge directly into the Diamond Fork Creek channel and would have a capacity of 370 cfs. An overflow spillway located on the left abutment would be designed to pass the probable maximum flood, which would have a peak inflow of 78,100 cfs and a volume of 32,500 acre-feet. Concrete aggregate for the dam would most likely be obtained from the reservoir basin; however, three commercial gravel pits located near the mouth of Spanish Fork Canyon have been approved as sources for the dam. The construction program would be developed in cooperation with the USFS.

Monks Hollow Reservoir would have a total capacity of 33,100 acre-feet at its normal operating level of 5,555 feet. The water level would not fluctuate greatly on a daily basis, but in most years, the summer water level would decline from 5 to 35 feet. The reservoir would have a water surface area of 352 acres at its normal water level and about 270 acres at its minimum operating elevation.

A 2.3-mile-long access road would be constructed to the upstream side of Monks Hollow Dam to provide contractor access during construction and ultimately to provide permanent access to a day-use area on the north side of Monks Hollow Reservoir. The access road would begin at the existing Diamond Fork Road about 1.1 miles downstream of the Monks Hollow Dam site and traverse the bench land on the north side of the creek. The access road would be 20 feet wide and have an asphalt surface. During construction, the access road would provide access to the existing dirt road in Red Hollow for construction access to the reservoir area.

1.6.4.3 Main Conveyance Aqueduct

Under the MCAP Alternative, the Main Conveyance Aqueduct would be the same as described for the Proposed Action. The individual pipelines of the aqueduct and their dimensions are listed in Table 1-14.

1.6.4.4 Turnouts, Regulating Ponds, and Pumping Plant

1.6.4.4.1 Turnouts. Twenty-one turnouts would be constructed at various locations along the Main Conveyance Aqueduct to release water for local distribution. The turnout locations would be the same as those described for the Proposed Action (see Map 1-4). The turnout capacities are listed in Table 1-34. The capacities listed provide for operational flexibility and the total of their capacities is consequently greater than the flow capacity of the Main Conveyance Aqueduct. Turnouts EJ9, EJ10, and EJ11 would be constructed as part of the EJWEP.

1.6.4.4.2 Regulating Ponds. Turnout regulating ponds for the MCAP Alternative would be identical to those in the Proposed Action.

1.6.4.4.3 West Mona Pumping Plant. In the MCAP Alternative, the West Mona Pumping Plant would be identical to that in the Proposed Action.

1.6.4.5 Main Conveyance Reservoir

The MCAP Alternative would include the Main Conveyance Reservoir as described for the Proposed Action.

Table 1-34 MCAP Alternative Turnout Capacities	
Turnout	**Turnout Capacity (cfs)**
Southern Utah County	
SU1	340
SU2	50*
SU3	15
SU4	10
SU5	70
SU6	160
SU7	60
Eastern Juab County	
EJ1	10
EJ2	10
EJ3	15
EJ4	15
EJ5	20
EJ6	15
EJ7	15
EJ8	15
EJ9	15
EJ10	15
EJ11	10
EJ12	20
EJ13	20
EJ14	20
*M&I water delivery only.	

1.6.4.6 Equalization Reservoirs

The MCAP Alternative would include the equalization reservoirs as described for the Proposed Action.

1.6.4.7 Recreation Trail

The MCAP Alternative would include the recreation trail as described for the Proposed Action.

1.6.4.8 Pre-Construction Activities

1.6.4.8.1 Surveying Activities. Prior to surveying, permits or rights-of-entry would be acquired as necessary. Areas to be surveyed would include the pipeline right-of-way, turnouts, regulating ponds, equalization reservoirs, Main Conveyance Reservoir, and pumping plant.

1.6.4.8.2 Right-of-Way Acquisition. Construction of Monks Hollow Dam and Reservoir would require 430 acres of permanent right-of-way and 25 acres of temporary right-of-way, all in the Uinta National Forest. Construction of the Main Conveyance Aqueduct and its associated facilities would require 563 acres of permanent right-of-way and 541 acres of temporary right-of-way, the same amount of right-of-way as under the Proposed Action. The land acquisition procedures would be the same as described for the Proposed Action.

1.6.4.9 Pipeline Construction Procedures

The process of constructing the Main Conveyance Aqueduct under the MCAP Alternative would be the same as that described under the Proposed Action. Major crossings and crossing methods would include all the Main Conveyance Aqueduct crossings in the Proposed Action. The land disturbance that would result from the MCAP Alternative is listed in Table 1-35.

Table 1-35
Land Disturbance Resulting from the MCAP and MCAPW Alternatives (acres)

Project Feature	Land Area Temporarily Disturbed During Construction	Land Area to be Revegetated	Land Area Permanently Disturbed
Monks Hollow Dam and Reservoir			
All facilities	455.0	55.0	400.0
Main Conveyance Aqueduct and Associated Features			
Pipeline and Turnouts	948.4	907.7	40.7[a]
Regulating Ponds	9.8	0.0	9.8
West Mona Pumping Plant	34.3	30.7	3.6
Equalization Reservoirs	6.0	4.0	2.0
Main Conveyance Reservoir[b]	38.4	3.4	35.0
Access Roads	4.6	4.6	0.0
Construction Staging Areas	48.0	48.0	0.0
Recreation Trail[c]	14.8	0.0	14.8
Total Acres	**1,559.3**	**1,053.4**	**505.9**

[a]Includes 38.2 acres of permanent disturbance related to the recreation trail and 2.5 acres of permanent disturbance related to the turnouts.
[b]Includes 3.4 acres of temporary disturbance for connecting pipeline.
[c]Does not include 38.2 acres associated with pipeline and turnouts.

1.6.4.10 Construction Staging Areas and Access Roads

Under the MCAP Alternative, the eight temporary construction staging areas and the temporary access roads needed for the construction of the Main Conveyance Aqueduct would be the same as those described in the Proposed Action.

1.6.4.11 Erosion Control and Site Restoration

Under the MCAP Alternative, the erosion control activities and revegetation of the areas impacted by construction activities would be the same as those described under the Proposed Action.

1.6.4.12 Maintenance

The maintenance of the SFN System under the MCAP Alternative would be the same as that described for the Proposed Action.

1.6.4.13 Construction Schedule, Work Force, Equipment, Materials, and Costs

After the necessary approvals and federal funding have been obtained, construction of the Main Conveyance Aqueduct and associated facilities is projected to take a period of 10 years, the same as for the Proposed Action, which is shown in Table 1-22 and in Figure 1-18.

The average number of construction personnel required per month for each pipeline segment of the Main Conveyance Aqueduct and the typical construction equipment used would be the same as for the Proposed Action. These requirements are shown in Tables 1-22 and 1-19, respectively. Selected construction material requirements are listed in Table 1-36. Construction costs for the MCAP Alternative, combined with the cost of constructing Monks Hollow Dam and Reservoir, are estimated to be approximately $298 million, or 96 percent of the cost of the Proposed Action.

Table 1-36
Construction Material Requirements for the MCAP Alternative*

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Pipe Lining and Coating	25,000
	Valve Vaults	400
	Pumping Plant	500
	Equalization Reservoirs	6,000
	Turnout Ponds	300
	Total	**32,200**
Steel (lbs)	Concrete Reinforcing	1,070,000
	Pipe Cylinder	152,052,000
	Pumps and Motors	43,000
	Turnout Valves	92,000
	Total	**153,257,000**

*Does not include construction material requirements for Monks Hollow Dam and Reservoir.

1.6.5 MCAPW Alternative

The MCAPW Alternative would include the construction, operation, and maintenance of the Main Conveyance Aqueduct, a 43.5-mile pipeline, and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) to deliver Bonneville Unit irrigation water from the terminus of the Diamond Fork Pipeline to eastern Juab County and the Santaquin area of southern Utah County as well as to deliver Bonneville Unit M&I water to southern Utah County secondary water systems (see Map 1-7). The agricultural area to be provided with Bonneville Unit

irrigation water with the MCAPW Alternative would be the same as in the Proposed Action. The physical facilities of the Main Conveyance Aqueduct under the MCAPW Alternative would be the same as those of the MCAPW-DFT Alternative. However, instead of the "Diamond Fork Tunnel Alternative," Monks Hollow Dam and Reservoir would be constructed as described for the MCAP Alternative to divert water into the Diamond Fork Pipeline. A turnout would be constructed at the end of the Diamond Fork Pipeline to release water to the Spanish Fork River.

The MCAPW Alternative differs from the Proposed Action in that 1) it would not include the "Diamond Fork Tunnel Alternative," 2) it would depend on the construction of Monks Hollow Dam and Reservoir to regulate storage in Diamond Fork Canyon and to divert water into the Diamond Fork Pipeline, 3) the Main Conveyance Aqueduct would not carry SVP water, 4) the High Line Canal would not be replaced by the Main Conveyance Aqueduct, 5) the Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct would be constructed parallel to the High Line Canal, and 6) M&I water would be provided at aqueduct turnouts for direct delivery to cities.

1.6.5.1 Operation of the MCAPW Alternative

1.6.5.1.1 Transbasin Diversion. Under the MCAPW Alternative, the transbasin diversion from Strawberry Reservoir would be the same as with the Proposed Action, consisting of an average of 61,500 acre-feet of SVP water and 101,900 acre-feet of Bonneville Unit water per year. The water released from Monks Hollow Reservoir would be the same as for the MCAP Alternative, consisting of the following:

• SVP water from Strawberry Reservoir	61,500 acre-feet
• Bonneville Unit water from Strawberry Reservoir	101,900 acre-feet
• Natural flow of Diamond Fork Creek and Strawberry Tunnel seepage	24,500 acre-feet
	187,900 acre-feet
• Evaporation loss from Monks Hollow Reservoir	- 1,000 acre-feet
	186,900 acre-feet

Under the MCAPW Alternative, the annual water volumes would be distributed as follows: an average of about 59,700 acre-feet would be released at Monks Hollow Dam to Diamond Fork Creek and about 127,200 acre-feet would be released into the Diamond Fork Pipeline. Both releases would be mixtures of SVP irrigation water, natural creek flow, and Bonneville Unit water. At the downstream end of the Diamond Fork Pipeline, all SVP irrigation and natural flow waters in the pipeline would be released to the Spanish Fork River and 71,100 acre-feet of Bonneville Unit irrigation and M&I water would continue into the Main Conveyance Aqueduct.

1.6.5.1.2 Water Delivery. The 71,100 acre-feet of water conveyed in the Main Conveyance Aqueduct would consist of approximately 13,200 acre-feet of irrigation water for the Spanish Fork area, 6,000 acre-feet of irrigation water for the Santaquin area, 40,700 acre-feet of irrigation water for eastern Juab County (including 4,400 acre-feet delivered to Mona Reservoir), and 11,200 acre-feet of M&I water for delivery in southern Utah County. Reusable return flows from this water would be 25,500 acre-feet.

The water conveyed in the Spanish Fork River would consist of 8,500 acre-feet of Bonneville Unit irrigation water for delivery in the Spanish Fork area, 21,300 acre-feet of Bonneville Unit water for delivery to Utah Lake, the entire 61,500 acre-feet of SVP water, and the natural flows of Diamond Fork Creek and the Spanish Fork River. The distribution of the Bonneville Unit and SVP waters would be the same as described for the MCAP Alternative, which is shown in Table 1-30.

Main Conveyance Aqueduct Turnout SU1 would release 4,000 acre-feet of Bonneville Unit irrigation water and 6,300 acre-feet of M&I water for use in the Spanish Fork area. Turnout SU2 would release 4,900 acre-feet of

M&I water and about 1,200 acre-feet of Bonneville Unit irrigation water. The rest of the Main Conveyance Aqueduct turnouts would release the same amounts of irrigation water as the MCAPW-DFT Alternative.

As in the Proposed Action, about 11,700 acre-feet of Bonneville Unit return flow would be available in Mona Reservoir for irrigation use in the west Mona and Elberta areas and for delivery to Utah Lake. Except for the exclusion of SVP water from the Main Conveyance Aqueduct, the delivery of Bonneville Unit irrigation water would be coordinated with local water supplies in the same way as described under the Proposed Action.

1.6.5.1.3 Streamflows. The flows in Sixth Water Creek and lower Diamond Fork Creek would be the same as for the MCAP Alternative. The projected flows in the upper Spanish Fork River under the MCAPW Alternative are shown in Table 1-37. The flows consist of Strawberry Reservoir water conveyed in Diamond Fork Creek and the natural flows of Diamond Fork Creek and the Spanish Fork River. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-37
Streamflows in the Upper Spanish Fork River Resulting from the MCAPW Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	147	114	114	115	128	157	282	514	478	467	346	228
acre-feet	9,050	6,780	7,030	7,040	7,120	9,670	16,770	31,610	28,450	28,710	21,260	13,580
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	106	94	92	93	99	108	101	241	377	340	200	203
Wet Year[c]	155	108	108	120	131	150	1,076	1,913	736	576	722	408
Lowest and highest monthly average flows (cfs)												
Lowest[d]	88	91	90	93	94	101	101	226	264	249	159	124
Highest[d]	282	160	163	172	178	249	1,076	1,913	736	576	722	408

[a]Rounded to nearest cfs
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.5.1.4 Operating Entity and Other Operational Aspects. The CUWCD would operate the MCAPW Alternative. A 1998 operating contract with SWUA would be needed to cover operation of the Diamond Fork System and Main Conveyance Aqueduct. Contracts would be required with individual irrigation companies in the Spanish Fork area to cover delivery of Bonneville Unit water to their systems and with the Strawberry High Line Canal Company to provide for conveyance of Bonneville Unit water in the High Line Canal. These contracts and others are discussed in Section 1.7.

The projected operational life would also be the same as described for the Proposed Action. The MCAPW Alternative would have the same automated control system as that described for the Proposed Action. Power requirements for the SFN System under the MCAPW Alternative would be the same as for the Proposed Action.

1.6.5.2 Main Conveyance Aqueduct

The Main Conveyance Aqueduct would run from the confluence of Diamond Fork Creek and the Spanish Fork River to the Nephi area, as described under the MCAPW-DFT Alternative. The flow capacities of the Spanish Fork, Salem Bench, and Payson Pipelines would be less than those of the Proposed Action, and the alignments of the Salem Bench and Payson Pipelines would not replace the High Line Canal, but lie parallel to the canal. The aqueduct design is summarized in Table 1-25.

1.6.5.3 Turnouts, Regulating Ponds, and Pumping Plant

1.6.5.3.1 Diamond Fork Pipeline Turnout. A 215 cfs turnout would be constructed at the end of the Diamond Fork Pipeline, as described in the MCAPW-DFT Alternative.

1.6.5.3.2 Main Conveyance Aqueduct Turnouts, Regulating Ponds, and Pumping Plant. Under the MCAPW Alternative, 21 turnouts would be constructed at the same locations along the Main Conveyance Aqueduct identified for the MCAPW-DFT Alternative (see Map 1-7). The turnout capacities for the southern Utah County turnouts are shown in Table 1-38. The turnouts in eastern Juab County would have the same capacities as described for the Proposed Action (see Table 1-15).

Table 1-38
MCAPW Alternative Turnout Capacities in Utah County

Turnout	Turnout Capacity (cfs)
SU1	135
SU2	75
SU3	5
SU4	5
SU5	30
SU6	70
SU7	60

The same four turnout regulating ponds described under the Proposed Action would be constructed along the Main Conveyance Aqueduct to incorporate Bonneville Unit water with local surface water supplies. The West Mona Pumping Plant would be included in the MCAPW Alternative and would be the same as described for the Proposed Action.

1.6.5.4 Main Conveyance Reservoir

The Main Conveyance Reservoir would be the same as that described for the Proposed Action.

1.6.5.5 Equalization Reservoirs

The equalization reservoirs would be the same as those described for the Proposed Action.

1.6.5.6 Recreation Trail

A recreation trail would not be built under the MCAPW Alternative.

1.6.5.7 Pre-Construction Activities

Pre-construction activities would be the same as those described under the Proposed Action. The permanent and temporary easements widths for both the Salem Bench and Payson Pipelines in the MCAPW Alternative would both be 100 feet. The right-of-way lengths and widths for the Main Conveyance Aqueduct would be the same as for the MCAPW-DFT Alternative (see Table 1-27).

Construction of Monks Hollow Dam and Reservoir would require 430 acres of permanent right-of-way and 25 acres of temporary right-of-way, all in the Uinta National Forest. Construction of the Main Conveyance Aqueduct and its associated facilities would require 547 acres of permanent right-of-way and 540 acres of temporary right-of-way, the same as required under the MCAPW-DFT Alternative. The land acquisition procedures would be the same as described for the Proposed Action.

The land disturbance would be the same as that caused by the construction and operation of the Main Conveyance Aqueduct under the MCAPW-DFT Alternative.

1.6.5.8 Pipeline Construction Procedures

The pipeline construction procedures for the MCAPW Alternative would be the same as those described for the Main Conveyance Aqueduct in the Proposed Action.

1.6.5.9 Construction Staging Areas

The MCAPW Alternative would have the same eight construction staging areas as the Main Conveyance Aqueduct would have in the Proposed Action.

1.6.5.10 Erosion Control and Revegetation

Under the MCAPW Alternative, the erosion control activities and revegetation of the areas impacted by construction activities would be the same as those described for the Main Conveyance Aqueduct under the Proposed Action.

1.6.5.11 Maintenance

Maintenance of the SFN System under the MCAPW Alternative would be the same as that described for the Proposed Action.

1.6.5.12 Construction Schedule, Work Force, Equipment, Materials, and Costs

For the MCAPW Alternative, the construction schedule, work force, and equipment needed would be the same as that described for the Main Conveyance Aqueduct under the Proposed Action (see Tables 1-22 and 1-19). A list of construction material requirements is provided in Table 1-39. The construction cost for the MCAPW Alternative, together with the cost of Monks Hollow Dam and Reservoir, is estimated to be $267 million or 86 percent of the cost of the Proposed Action.

Table 1-39
Construction Material Requirements for the MCAPW Alternative

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Pipe Lining and Coating	23,000
	Valve Vaults	380
	Pumping Plant	500
	Equalization Reservoirs	6,000
	Turnout Ponds	300
	Total	**30,180**
Steel (lbs)	Concrete Reinforcing	1,003,000
	Pipe Cylinder	126,373,000
	Pumps and Motors	43,000
	Turnout Valves	79,000
	Total	**127,498,000**

1.6.6 MCATC Alternative

The MCATC Alternative would include the construction, operation, and maintenance of a 40.1-mile Main Conveyance Aqueduct and related facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. Agricultural areas to be provided with Bonneville Unit irrigation water with the MCATC Alternative would be the same as in the Proposed Action. Monks Hollow Dam and Reservoir would be constructed to divert water into the Diamond Fork Pipeline.

The MCATC Alternative differs from the Proposed Action in that 1) the Main Conveyance Aqueduct would tunnel through Loafer Mountain, as shown on Map 1-9, instead of lying entirely within Spanish Fork Canyon, 2) the Main Conveyance Aqueduct alignment in the Salem and Payson areas would include tunnels through Tithing Mountain and Dry Mountain near Peteetneet Creek, 3) it would not include the "Diamond Fork Tunnel Alternative," 4) it would depend on the construction of Monks Hollow Dam and Reservoir to regulate storage in Diamond Fork Canyon and to divert water into the Diamond Fork Pipeline, and 5) M&I water would be delivered directly from Strawberry Reservoir instead of through a groundwater exchange.

1.6.6.1 Operation of the MCATC Alternative

1.6.6.1.1 Transbasin Diversion. Under the MCATC Alternative, the transbasin diversion from Strawberry Reservoir would be the same as with the Proposed Action, consisting of an average of 61,500 acre-feet of SVP water and 101,900 acre-feet of Bonneville Unit water per year. The water released from Monks Hollow Reservoir would be the same as the MCAP Alternative (i.e., 61,500 acre-feet of SVP water and 100,900 acre-feet of Bonneville Unit water). The division of these releases and the releases of natural streamflow between Diamond Fork Creek and the Diamond Fork Pipeline would be the same as under the MCAP Alternative.

1.6.6.1.2 Water Delivery. Under the MCATC Alternative, the same amount of water would be provided as in the MCAP Alternative, including return flows, and the means of providing the M&I water would be similar to that described for the MCAP Alternative (see Section 1.6.4.1.2). Average flows of 127,200 acre-feet per year would enter the Main Conveyance Aqueduct from the Diamond Fork Pipeline. The Main Conveyance Aqueduct turnouts in the Spanish Fork area would be located in different places because of the aqueduct alignment through Loafer Maintain (as shown on Map 1-9). Turnout SU1 would be located in Spanish Fork Canyon near the mouth of Pole Canyon and would release approximately 37,700 acre-feet of water for conveyance to the mouth of Spanish Fork Canyon by a local distribution pipeline (see Section 1.9.7 for discussion of the local projects that would accompany the MCATC Alternative). The water carried in that distribution pipeline would include an irrigation supply of about 10,100 acre-feet for the Mapleton Lateral service area, about 22,800 acre-feet of irrigation water to be delivered to the SVP Power Canal, and about 4,800 acre-feet of M&I water.

The remaining flow of 89,500 acre-feet in the Main Conveyance Aqueduct would be conveyed through Loafer Mountain Tunnel for delivery to southern Utah and eastern Juab Counties. About 48,800 acre-feet, including 6,400 acre-feet of M&I water, would be distributed at various turnouts in southern Utah County and 40,700 acre-feet would be conveyed to eastern Juab County, where it would be distributed in the same manner as described under the Proposed Action. About 21,300 acre-feet of water would also be released from Strawberry Reservoir to meet instream flow requirements and for delivery to Utah Lake for Jordanelle Reservoir exchanges. Return flows from the use of Bonneville Unit water and their uses would be the same as in the Proposed Action.

1.6.6.1.3 Streamflows. The MCATC Alternative flows in Sixth Water and Diamond Fork Creeks would differ from those in the Proposed Action, but would be the same as for the MCAP and MCAPW Alternatives. The average monthly flows in the Spanish Fork River would be the same as for the MCAP Alternative.

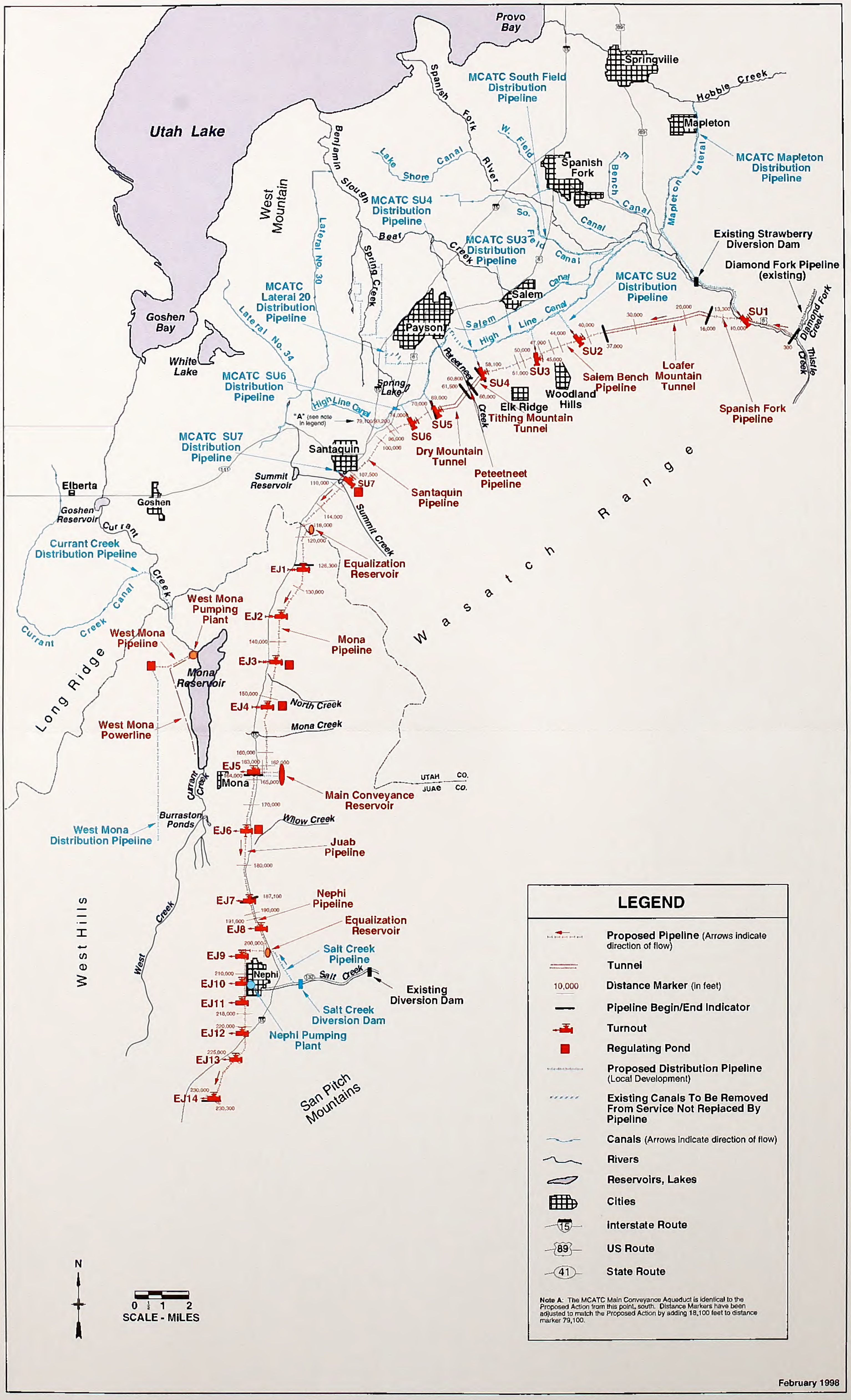
1.6.6.1.4 Operating Entity and Other Operational Aspects. The CUWCD would operate the MCATC Alternative under a 1998 operating contract with SWUA that would address the conveyance of SVP water in the Main Conveyance Aqueduct. Other agreements would also be needed as discussed in Section 1.7. The projected operational life would be the same as described for the Proposed Action, with the addition of the three tunnels, which would have an operational life of 75 years. The automated control system, coordination with local water supplies, and power requirements of the MCATC Alternative would be the same as those described for the MCAP Alternative.

1.6.6.2 Pipeline Alignment

The MCATC Alternative Main Conveyance Aqueduct has been divided into 10 pipeline segments (see Map 1-9 for locations), which are listed in Table 1-40 and described in the following paragraphs. The right-of-way easement widths for the Main Conveyance Aqueduct under the MCATC Alternative is shown in Table 1-41.

1.6.6.2.1 Spanish Fork Pipeline. The Spanish Fork Pipeline would begin at distance marker 300 on the north side of Highway 6 at Diamond Fork Road. It would proceed west along the north side of Highway 6 to distance marker 13,300. At this point, the pipeline would cross under Highway 6, the Denver and Rio Grande Western Railroad, and the Spanish Fork River. After crossing the river, the pipeline would proceed across Pole Canyon to distance marker 16,000. The pipeline would be 3 miles long and have a capacity of 510 cfs.

1.6.6.2.2 Loafer Mountain Tunnel. The Loafer Mountain Tunnel would begin at distance marker 16,000. The tunnel would travel through Loafer Mountain and end at the tunnel outlet at distance marker 37,000. The tunnel would be 4 miles long and have a capacity of 435 cfs.



Map 1-9
Main Conveyance Aqueduct
Under the MCATC Alternative

Table 1-40
Pipeline Segments Associated with the MCATC Alternative

Pipeline Segment Name	Distance Marker (feet)	Length (miles)	Diameter (inches)	Capacity (cfs)
Spanish Fork Pipeline	300 to 16,000	3.0	108	510
Loafer Mountain Tunnel	16,000 to 37,000	4.0	108	435
Salem Bench Pipeline	37,000 to 58,100	4.0	108	435 - 357
Tithing Mountain Tunnel	58,100 to 60,800	0.5	108	357
Peteetneet Pipeline	60,800 to 61,500	0.1	108	357
Dry Mountain Tunnel	61,500 to 69,000	1.4	108	357
Santaquin Pipeline	69,000 to 126,300[a]	7.4	84	357 - 185
Mona Pipeline[b]	126,300 to 164,000	7.1	84	178 - 146
Juab Pipeline	164,000 to 187,100	4.4	84	132 - 117
Nephi Pipeline	187,100 to 230,300	8.2	60 - 30	105 - 22
Subtotal (Main Conveyance Aqueduct Length)		**40.1**		
Distribution Pipelines at Turnouts EJ1 and EJ4[b]		2.1	24 - 20	15 - 10
Total		**42.2**		

[a]The Main Conveyance Aqueduct alignments under the MCATC and MCAT Alternatives would be identical to the Proposed Action from distance marker 79,100 to the terminus of the Main Conveyance Aqueduct at distance marker 230,300. Distance markers have been adjusted to match the Proposed Action by adding 18,100 feet within this segment.
[b]Four distribution lines totaling 2.1 miles would be built with the Mona Pipeline to convey water from Turnouts EJ1 through EJ4 to the west side of I-15. These distribution lines would be between 0.4 and 0.6 mile in length.

1.6.6.2.3 Salem Bench Pipeline. The Salem Bench Pipeline would begin at the Loafer Mountain Tunnel outlet at distance marker 37,000. The pipeline would pass north of the communities of Woodland Hills and Elk Ridge and south of the High Line Canal along the Salem Bench to the Tithing Mountain Tunnel inlet at distance marker 58,100. The pipeline would be 4 miles long, and its capacity would decrease from 435 cfs to 357 cfs.

1.6.6.2.4 Tithing Mountain Tunnel. The Tithing Mountain Tunnel would begin at distance marker 58,100. The tunnel would be 0.5 mile long and would end at distance marker 60,800 in Payson Canyon. The tunnel would have a capacity of 357 cfs.

1.6.6.2.5 Peteetneet Pipeline. The Peteetneet Pipeline would begin at distance marker 60,800 in Payson Canyon and end at the Dry Mountain Tunnel inlet at distance marker 61,500. The pipeline would be 0.1 mile long and have a capacity of 357 cfs.

1.6.6.2.6 Dry Mountain Tunnel. The Dry Mountain Tunnel would begin at distance marker 61,500. The tunnel would travel through Dry Mountain and end at the tunnel outlet at distance marker 69,000. This segment would be 1.4 miles long and have a capacity of 357 cfs.

Table 1-41
Main Conveyance Aqueduct Right-of-Way Easement Widths by Distance Marker for the MCATC and MCAT Alternatives

Distance Marker		Length (feet)	Width (feet)	
From	To		Temporary Easements	Permanent Easements
300	3,600	3,300	0	50
3,600	4,100	500	0	75
4,100	6,400	2,300	0	50
6,400	6,600	200	0	75
6,600	6,740	140	85	100
6,740	7,920	1,180	100	100
7,920	8,220	300	65	100
8,220	9,030	810	25	100
9,030	9,430	400	65	100
9,430	12,230	2,800	100	100
12,230	12,430	200	70	100
12,430	13,300	870	0	50
13,300	16,100	2,800	100	100
16,100	36,700	20,600	19[a]	0
36,700	58,100	21,400	100	100
58,100	60,800	2,700	4[b]	0
60,800	62,000	1,200	100	100
62,000	69,900	7,900	8[c]	0
69,900	181,900	112,000	100	100
181,900	230,300	30,300	60	60

[a]This section of the route includes Loafer Mountain Tunnel. The 19 acres of temporary disturbance accounts for two 2-acre work areas for equipment staging and a 15-acre spoil disposal site.
[b]This section of the route includes Tithing Mountain Tunnel. Two acres of work area would be needed for equipment staging and 2 acres for spoil disposal.
[c]This section of the route includes Dry Mountain Tunnel. Two acres of work area for equipment staging would be needed and 6 acres for spoil disposal.

1.6.6.2.7 Santaquin Pipeline. The Santaquin Pipeline would begin at the Dry Mountain Tunnel outlet at distance marker 69,000. The pipeline would proceed southwest on the east side of Highway 6 to Santaquin and terminate at distance marker 126,300. The pipeline would be 7.4 miles long, and its capacity would decrease from 357 to 185 cfs.

1.6.6.2.8 Mona, Juab, and Nephi Pipelines. The alignments for the Mona, Juab, and Nephi Pipelines would be the same as those described under the Proposed Action.

1.6.6.3 Turnouts, Regulating Ponds, and Pumping Plant

Under the MCATC Alternative, 21 turnouts and 4 regulating ponds would be constructed at various locations (see Map 1-9) along the Main Conveyance Aqueduct to deliver irrigation water to local distribution systems. The West Mona Pumping Plant would also be constructed. The turnouts would be the same as described for the Proposed Action, except that under the MCATC Alternative, the locations of Turnouts SU1 through SU6 would change (see Map 1-9). The turnout capacities and sizes and the permanent disturbance associated with the regulating ponds would be the same as that described for the Proposed Action (see Tables 1-15 and 1-16). The turnouts, regulating ponds, and the pumping plant would be designed and constructed as described under the Proposed Action.

1.6.6.4 Main Conveyance Reservoir

Under the MCATC Alternative, there would be no changes to the Main Conveyance Reservoir as described for the Proposed Action.

1.6.6.5 Equalization Reservoirs

The equalization reservoirs would be the same as those described in the Proposed Action.

1.6.6.6 Recreation Trail

The recreation trail would not be built under the MCATC Alternative.

1.6.6.7 Pre-Construction Activities

Pre-construction activities for the MCATC Alternative would be the same as those described under the Proposed Action. Construction of Monks Hollow Dam and Reservoir would require 430 acres of permanent right-of-way and 25 acres of temporary right-of-way, all in the Uinta National Forest. Construction of the Main Conveyance Aqueduct and its associated facilities would require 473 acres of permanent right-of-way and 456 acres of temporary right-of-way. The land acquisition procedures would be the same as described for the Proposed Action.

1.6.6.8 Pipeline Construction Procedures

The steps required for constructing the pipeline segments of the Main Conveyance Aqueduct in the MCATC Alternative would be similar to those required under the Proposed Action, except as noted below. The areas temporarily and permanently disturbed by the pipeline, turnouts, and regulating ponds for the MCATC Alternative. The same crossing methods described under the Proposed Action would apply to the MCATC Alternative are shown in Table 1-42. The features that would be crossed by the MCATC Alternative are shown in Table 1-43. The crossing locations are shown on Map 1-9.

1.6.6.9 Tunnel Construction Procedures

The MCATC Alternative would require the excavation of three tunnels. All three tunnels would be free-flowing (i.e., not under pressure) and have a horseshoe-shaped cross section. Preliminary geotechnical investigations performed by the USBR for the 1988 DPR (USBR 1988a) indicate that the rock in which the tunnels would be constructed is suited for tunnel construction, but supplemental support, such as steel liner plate or rock bolts, would likely be required. All tunnels would be lined with concrete to provide a smooth surface against which the water would flow.

Table 1-42 Land Disturbance Resulting from the MCATC and MCAT Alternatives			
Project Feature	**Acres Disturbed During Construction**	**Acres Revegetated**	**Acres Permanently Disturbed**
Monks Hollow Dam and Reservoir			
All facilities	455.0	55.0	400.0
Main Conveyance Aqueduct and Associated Features			
Pipeline and Turnouts	766.7	765.2	1.5
Regulating Ponds	9.8	0.0	9.8
West Mona Pumping Plant	34.3	30.7	3.6
Equalization Reservoirs	6.0	4.0	2.0
Main Conveyance Reservoir[a]	38.4	3.4	35.0
Access Roads	4.6	4.6	0.0
Construction Staging Areas[b]	69.0	69.0	0.0
Total	**1,383.8**	**931.9**	**451.9**

[a]Includes 3.4 acres of temporary disturbance for connecting pipeline.
[b]Includes 15 acres related to the tunnel spoil disposal site.

Table 1-43 Major Crossings and Crossing Methods Associated with the MCATC and MCAT Alternatives		
Feature To Be Crossed	**Pipeline Segment**	**Crossing Method**
Highway 6	Spanish Fork Pipeline	Tunneling
Denver and Rio Grande Western Railroad	Spanish Fork Pipeline	Tunneling
Utah Railroad	Spanish Fork Pipeline	Tunneling
Spanish Fork River	Spanish Fork Pipeline	Open trench
Payson Canyon Road	Peteetneet Pipeline	Open trench
Peteetneet Creek	Peteetneet Pipeline	Open trench
Summit Creek	Santaquin Pipeline	Open trench
North Creek	Mona Pipeline	Open trench
Mona Creek	Mona Pipeline	Open trench
I-15 at Mona	Mona Pipeline	Open trench
Willow Creek	Juab Pipeline	Open trench
State Route 41	Nephi Pipeline	Open trench
I-15 at south edge of Nephi	Nephi Pipeline	Boring and jacking
Union Pacific Railroad	Nephi Pipeline	Boring and jacking

All tunnels would likely be excavated with a tunnel boring machine, as shown in Figure 1-11, which loosens rock at the tunnel face by a cutting or crushing action, depending on the rock type. Removal of excavated material would be accomplished by using specially designed low-profile loaders, augers or conveyors, or trains of mine cars. If necessary, temporary tunnel support would use steel supports, erected immediately after excavation. Blocking would be placed between the steel support and the tunnel wall to prevent rock movement from starting. Lagging would also be placed between supports. The tunnel lining would be placed by using segmented steel forms in 20- to 30-foot increments. Wall pours would be made first, followed by arch pours. The concrete would be pumped into place, starting at the rear of the segment and moving forward.

Spoil from each of the three tunnels would be disposed at a site located approximately 2,000 feet west of the outlet portal of the Loafer Mountain Tunnel. The site is a bowl-shaped depression that, if filled in to match the elevations along its rim, could hold in excess of 600,000 cubic yards. Because the total estimated spoil volume from all three tunnels is less than 150,000 cubic yards, the depression would only be partially filled. The site is presently under private ownership, and an area of approximately 15 acres has been used for spoil disposal.

Topsoil from the spoil site would be removed and stockpiled. Spoil would be transported from the tunnel portals by truck and would be spread evenly within the depression. Upon completion of spoil transport, the stockpiled topsoil would be spread back over the site and reseeded.

1.6.6.10 Construction Staging Areas

Under the MCATC Alternative, the construction staging areas for the Main Conveyance Aqueduct would be the same as those described under the Proposed Action.

1.6.6.11 Erosion Control and Revegetation

Under the MCATC Alternative, erosion control and revegetation of the areas impacted by construction activities would be the same as described under the Proposed Action (see Appendix A, *Erosion Control, Revegetation, and Maintenance Plan*). However, tunneling activities under the MCATC Alternative would produce approximately 150,000 cubic yards of spoil. These spoil piles would be reclaimed as outlined in Appendix A.

1.6.6.12 Maintenance

Maintenance of the SFN System under the MCATC Alternative would be the same as that described for the Proposed Action.

1.6.6.13 Construction Schedule, Work Force, Equipment, Materials, and Costs

After the necessary approvals and federal funding have been obtained, construction of the SFN System is projected to take a period of 9 years. A construction summary, including the average number of construction personnel required per month is provided in Table 1-44, and the construction schedule for the MCATC Alternative is shown in Figure 1-22. This schedule is based on the assumptions that a Record of Decision would be obtained by spring 1999 and that construction would begin in the fall of 1999. The projections are subject to change as the construction program and schedule are refined. (See Table 1-19 for the list of equipment to be used for the construction of the MCAT Alternative.) A list of construction material requirements is provided in Table 1-45. The construction cost for the MCATC Alternative, together with the cost of Monks Hollow Dam and Reservoir, is estimated to be $324 million, or 104 percent of the cost of the Proposed Action.

Table 1-44
Construction Summary for the MCATC and MCAT Alternatives

Pipeline Segment	Length (miles)	Average Production (feet/day)	Construction Duration (# work days)	Construction Schedule	Average Personnel (persons/month)
Spanish Fork Pipeline	3.0	64	250	October 1999 to September 2000	20 to 30
Loafer Mountain Tunnel	4.0	25	840	November 2000 to February 2003	20 to 30
Salem Bench Pipeline	4.0	84	250	January 2002 to January 2003	20 to 30
Tithing Mountain Tunnel	0.5	25	110	February 2002 to August 2003	20 to 30
Peteetneet Pipeline	0.1	7	110	February 2003 to August 2003	20 to 30
Dry Mountain Tunnel	1.4	25	340	October 2003 to February 2005	20 to 30
Santaquin Pipeline	7.4	174	220	March 2004 to January 2005	20 to 30
Mona Pipeline	9.2	151	250	April 2005 to April 2006	20 to 30
Juab Pipeline	4.4	116	200	July 2006 to May 2007	20 to 30
Nephi Pipeline	8.2	173	250	August 2007 to August 2008	20 to 30
Total	**42.2**				

Table 1-45
Construction Material Requirements for the MCATC Alternative

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Pipe Lining and Coating	20,700
	Tunnels	15,100
	Valve Vaults	380
	Pumping Plant	500
	Equalization Reservoirs	6,000
	Turnout Ponds	300
	Total	**42,980**
Steel (lbs)	Concrete Reinforcing	1,067,000
	Tunnels	818,000
	Pipe Cylinder	92,187,000
	Pumps and Motors	43,000
	Turnout Valves	88,000
	Total	**94,203,000**

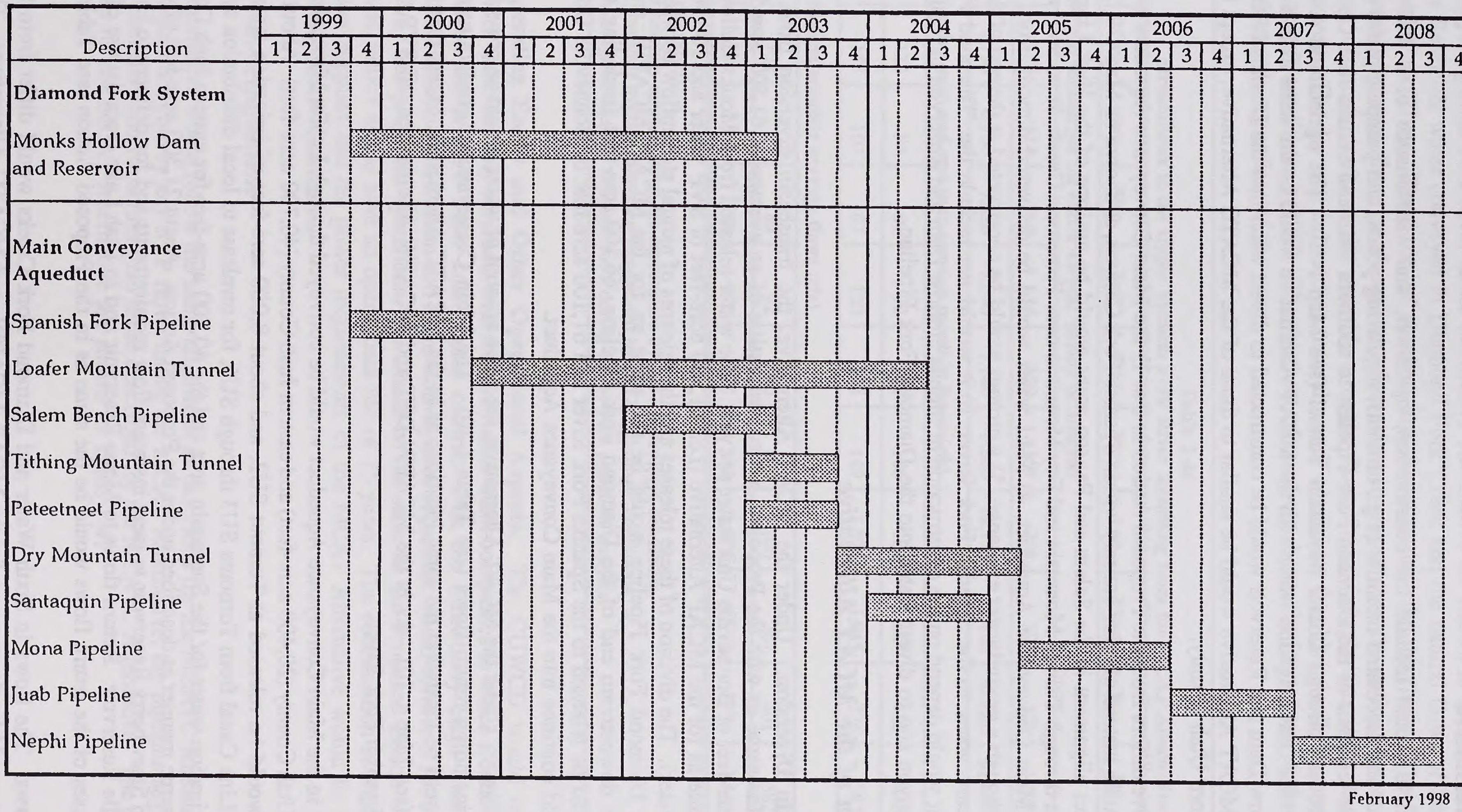


Figure 1-22
Construction Schedule for MCATC and MCAT Alternatives

1.6.7 MCAT Alternative

The MCAT Alternative would include the construction, operation, and maintenance of a 40.1-mile Main Conveyance Aqueduct and associated facilities (e.g., turnouts, regulating ponds, and pumping plant) designed to deliver water from the terminus of the Diamond Fork Pipeline to southern Utah and eastern Juab Counties. The aqueduct would be routed through Loafer Mountain Tunnel (see Map 1-10). The agricultural acreage to be provided with Bonneville Unit irrigation water with the MCAT Alternative would be the same as in the Proposed Action. Monks Hollow Dam and Reservoir would be constructed to divert water into the Diamond Fork Pipeline. The facilities of the MCAT Alternative would be similar to those of the MCATC Alternative, except for some of the turnouts in southern Utah County.

The MCAT Alternative differs from the Proposed Action in that 1) the Main Conveyance Aqueduct would tunnel through Loafer Mountain instead of lying entirely within Spanish Fork Canyon, as shown on Map 1-9, 2) the Main Conveyance Aqueduct alignment in the Salem and Payson areas would be upslope of the High Line Canal and would include tunnels through Tithing Mountain and Dry Mountain near Peteetneet Creek, 3) no SVP water would be conveyed in the Main Conveyance Aqueduct, 4) M&I water would be delivered directly from Strawberry Reservoir instead of though a groundwater exchange, 5) a turnout would be constructed at the end of the Diamond Fork Pipeline to release water to the Spanish Fork River, 6) it would not include the "Diamond Fork Tunnel Alternative," and 7) it would depend on the construction of Monks Hollow Dam and Reservoir to regulate storage in Diamond Fork Canyon and to divert water into the Diamond Fork Pipeline.

1.6.7.1 Operation of the MCAT Alternative

1.6.7.1.1 Transbasin Diversion. Under the MCAT Alternative, the transbasin diversion from Strawberry Reservoir would be the same as with the Proposed Action, consisting of an average of 61,500 acre-feet of SVP water and 101,900 acre-feet of Bonneville Unit water per year. The water released from Monks Hollow Reservoir also would be the same as for the MCAP Alternative (i.e., 61,500 acre-feet of SVP water and 100,900 acre-feet of Bonneville Unit water). The division of these releases and the releases of natural streamflow between Diamond Fork Creek and the Diamond Fork Pipeline would be the same as for the MCAP, MCAPW, and MCATC Alternatives. At the downstream end of the Diamond Fork Pipeline, 66,100 acre-feet (including all the SVP irrigation water) would be released to the Spanish Fork River and 61,100 acre-feet of Bonneville Unit irrigation and M&I water would continue into the Main Conveyance Aqueduct.

1.6.7.1.2 Water Delivery. Under the MCAT Alternative, the same amount of water would be provided as in the MCAP Alternative, including return flows (see Table 1-30). The Main Conveyance Aqueduct turnouts in the Spanish Fork area would be located at the same locations as in the MCATC Alternative, except that there would be no Turnout SU1 (see Map 1-10). As in the MCAPW-DFT and MCAPW Alternatives, all SVP water would be conveyed in the Spanish Fork River.

The 61,100 acre-feet in the Main Conveyance Aqueduct would be conveyed through Loafer Mountain Tunnel for delivery to southern Utah County (20,400 acre-feet) and eastern Juab County (40,700 acre-feet). About 6,400 acre-feet of M&I water would be released at Turnout SU2, and about 8,000 acre-feet of irrigation water would be released to the High Line Canal from Turnouts SU3 through SU5, for rerelease to local distribution systems. The 6,000 acre-feet of irrigation water for the Santaquin area and the 40,700 acre-feet for eastern Juab County would be distributed in the same manner as described under the Proposed Action. About 21,300 acre-feet of water would also be released from Strawberry Reservoir to meet instream flow requirements and for delivery to Utah Lake for exchange to Jordanelle Reservoir. Return flows to Mona Reservoir and to Utah Lake from the use of Bonneville Unit water and the uses of the return flows would be the same as in the Proposed Action (see Table 1-7).

1.6.7.1.3 Streamflows. The flows in Sixth Water and Diamond Fork Creeks would differ from those in the Proposed Action, but would be the same as for the MCAP, MCAPW, and MCATC Alternatives. The projected

flows in the upper Spanish Fork River under the MCAT Alternative are shown in Table 1-46. The flows consist of Strawberry Reservoir water conveyed in Diamond Fork Creek and the natural flows of Diamond Fork Creek and the Spanish Fork River. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-46
Streamflows in the Upper Spanish Fork River Resulting from the MCAT Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	158	114	114	114	129	157	282	523	522	527	375	238
acre-feet	9,730	6,760	7,020	7,040	7,140	9,660	16,770	32,150	31,080	32,440	23,040	14,170
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	123	94	91	92	100	106	100	267	425	420	242	226
Wet Year[c]	167	107	107	120	125	149	1,076	1,915	726	587	388	352
Lowest and highest monthly average flows (cfs)												
Lowest[d]	104	91	89	92	90	100	100	267	401	382	214	152
Highest[d]	286	158	163	172	178	249	1,076	1,915	754	619	752	415

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.7.1.4 Operating Entity and Other Operational Aspects. The CUWCD would operate the MCAT Alternative under water delivery contracts with the individual water companies to which Bonneville Unit irrigation water is delivered and a 1998 water conveyance contract with the Strawberry High Line Canal Company. Operation of the Diamond Fork System and Main Conveyance Aqueduct would involve a 1998 operating contract with the SWUA. The projected operational life would be the same as the Proposed Action with the addition of the three tunnels, which would have an operational life of 75 years. The coordination of Bonneville Unit water with local water supplies and the power requirements of the MCAT Alternative would be the same as those described for the MCAP Alternative.

1.6.7.2 Pipeline Alignment

The MCAT Alternative would follow the same alignment as described for the MCATC Alternative. Because the SFN System would not convey any SVP flows under the MCAT Alternative, the pipeline segments would have different pipe diameters and capacities than those described for the MCATC Alternative. The pipe diameters and capacity factors for the MCAT Alternative are shown in Table 1-47.

Table 1-47
Pipeline Segments Associated with the MCAT Alternative

Pipeline Segment Name	Diameter (inches)	Capacity (cfs)
Spanish Fork Pipeline	90	275
Loafer Mountain Tunnel	90	275
Salem Bench Pipeline	90	275
Tithing Mountain Tunnel	90	275
Peteetneet Pipeline	90	275
Dry Mountain Tunnel	90	275
Santaquin Pipeline	90 - 78	275 - 185
Mona Pipeline	78 - 72	180 - 150
Juab Pipeline	72 - 60	130 - 105
Nephi Pipeline	60 - 30	95 - 20

1.6.7.3 Turnouts, Regulating Ponds, and Pumping Plant

Under the MCAT Alternative, 20 turnouts and 4 regulating ponds would be constructed at various locations (see Map 1-10 for locations) along the Main Conveyance Aqueduct for delivery of irrigation water to local distribution systems. The turnout locations would be the same as those described under the MCATC Alternative, except that Turnout SU1 would not be constructed. The size and location of the regulating ponds would be the same as those described for the Proposed Action (see Table 1-16). Turnouts and regulating ponds would be designed and constructed as described for the Proposed Action. The West Mona Pumping Plant would be the same as that described for the Proposed Action.

1.6.7.4 Main Conveyance Reservoir

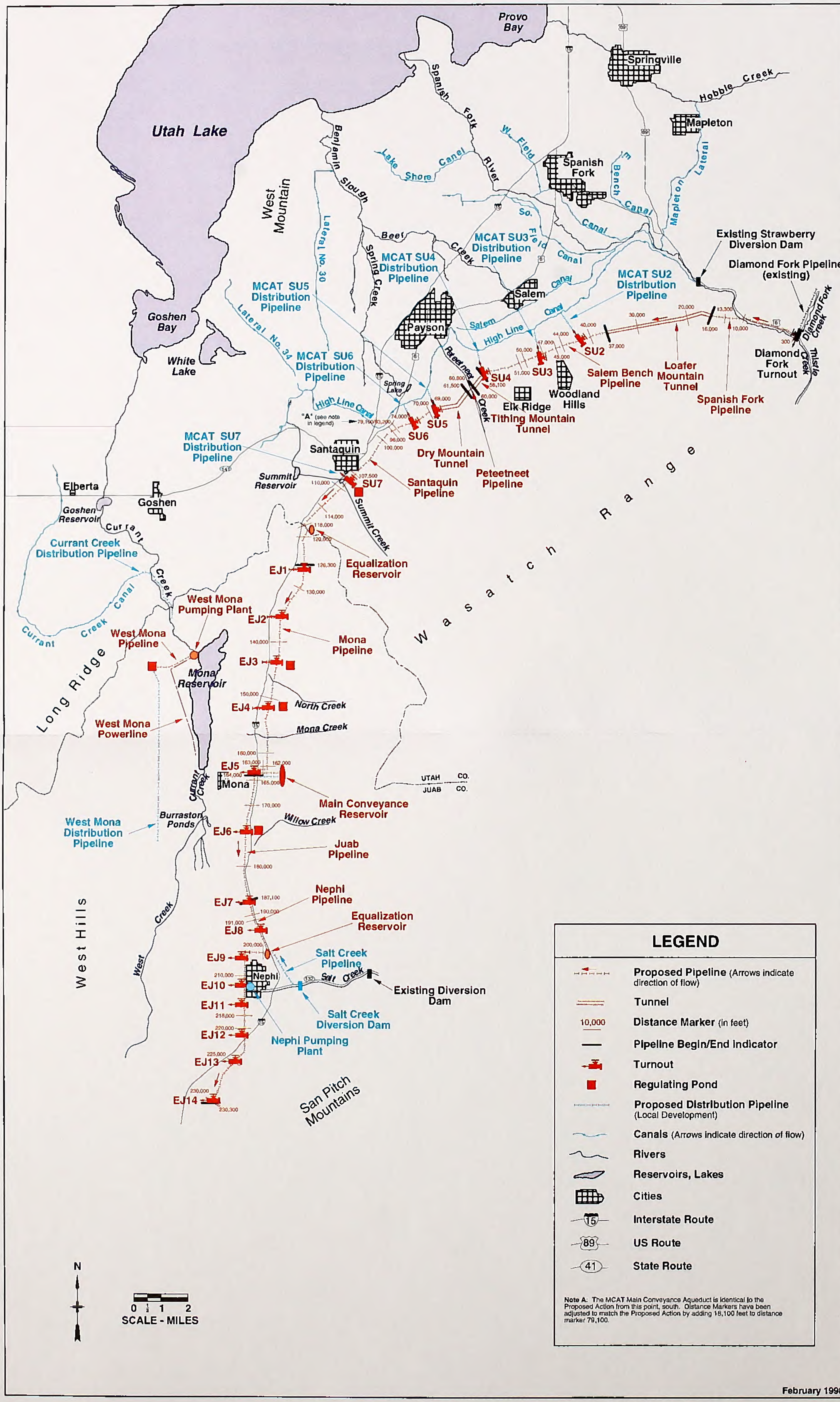
The Main Conveyance Reservoir would be the same as that described for the Proposed Action.

1.6.7.5 Equalization Reservoirs

The equalization reservoirs would be the same as those described for the Proposed Action.

1.6.7.6 Recreation Trail

A recreation trail would not be built under the MCAT Alternative.



Map 1-10
Main Conveyance Aqueduct
Under the MCAT Alternative

1.6.7.7 Pre-Construction Activities

Construction of Monks Hollow Dam and Reservoir would require 430 acres of permanent right-of-way and 25 acres of temporary right-of-way, all in Uinta National Forest. Construction of the Main Conveyance Aqueduct and its associated facilities would require 473 acres of permanent right-of-way and 456 acres of temporary right-of-way, the same as required under the MCATC Alternative. The land acquisition procedures would be the same as described for the Proposed Action.

1.6.7.8 Pipeline Construction Procedures

The steps required for constructing the MCAT Alternative would be the same as those described under the MCATC Alternative. The areas temporarily and permanently disturbed by the pipeline, turnouts, and regulating ponds for the MCAT Alternative are shown in Table 1-42. The crossings required for the MCAT Alternative would also be the same as those under the MCATC Alternative as shown in Table 1-43. The right-of-way needed for the MCAT Alternative would be the same as for the MCATC Alternative.

1.6.7.9 Tunnel Construction Procedures

Under the MCAT Alternative, the tunnel construction procedures would be the same as those described for the MCATC Alternative.

1.6.7.10 Construction Staging Areas

Under the MCAT Alternative, the construction staging areas would be the same as those described under the Proposed Action.

1.6.7.11 Erosion Control and Revegetation

Under the MCAT Alternative, the erosion control activities and revegetation of the areas impacted by construction activities would be the same as those described under the MCATC Alternative.

1.6.7.12 Maintenance

Maintenance of the SFN System under the MCAT Alternative would be the same as that described for the Proposed Action.

1.6.7.13 Construction Schedule, Work Force, Equipment, Materials, and Costs

The construction schedule for the MCAT Alternative would be the same as that described under the MCATC Alternative. The construction schedule for the MCAT Alternative is shown on Figure 1-22. The construction work force and typical construction equipment required to construct the MCAT Alternative would be the same as those described for the MCATC Alternative (see Tables 1-45 and 1-19, respectively). A list of construction material requirements is provided in Table 1-48. The SFN System construction cost for the MCAT Alternative, together with the cost of Monks Hollow Dam and Reservoir, is estimated to be $285 million, or 91 percent of the cost of the Proposed Action.

Table 1-48 Construction Material Requirements for the MCAT Alternative		
Type of Material	**Use of Material**	**Quantity**
Concrete (cubic yards)	Pipe Lining and Coating	18,600
	Tunnels	12,600
	Valve Vaults	380
	Pumping Plant	500
	Equalization Reservoirs	6,000
	Turnout Ponds	300
	Total	**38,380**
Steel (lbs)	Concrete Reinforcing	1,067,000
	Tunnels	679,000
	Pipe Cylinder	73,453,000
	Pumps and Motors	43,000
	Turnout Valves	88,000
	Total	**75,330,000**

1.6.8 No Action Alternative

Under the No Action Alternative, the SFN System would not be constructed. However, Bonneville Unit water stored in Strawberry Reservoir would still be delivered to Utah Lake through the Diamond Fork System. The Diamond Fork System would be completed in the manner prescribed in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990). In that document, the conditions without the SFN System were addressed by Diamond Fork System Alternative C, in which the proposed Three Forks Dam would be constructed to divert water into the Diamond Fork Pipeline. The completion of the Diamond Fork System is necessary to achieve the flow regulation in Diamond Fork Creek required by CUPCA and to deliver M&I water to Utah Lake for exchange to Jordanelle Reservoir.

1.6.8.1 Operation of the No Action Alternative

In the No Action Alternative, the SFN System would not be constructed. Instead, Bonneville Unit water and SVP water would be conveyed to the Bonneville Basin by the Diamond Fork System and the Spanish Fork River. The Diamond Fork System would be completed by constructing a dam and reservoir on Diamond Fork Creek at Three Forks. A pipeline would be constructed along Diamond Fork Creek to convey water from Three Forks Dam to the existing Diamond Fork Pipeline.

1.6.8.1.1 Transbasin Diversion. Under the No Action Alternative, 61,500 acre-feet of SVP water and 96,800 acre-feet of Bonneville Unit water (a total of 158,300 acre-feet per year) would be released from Strawberry Reservoir for irrigation and M&I use and for exchange to Jordanelle Reservoir. The number of acre-feet in each category is listed in Table 1-49.

Table 1-49
Transbasin Diversion from Strawberry Reservoir with the No Action Alternative

Component	Acre-Feet per Year
Bonneville Unit Water	
Irrigation water	3,500
M&I water[a]	11,200
Delivery to Utah Lake[b]	82,100
Subtotal	**96,800**
Strawberry Valley Project Water	61,500
Total	**158,300**
Distribution of Transbasin Diversion Between the Tunnels	
Syar Tunnel release volume	141,200
Strawberry Tunnel release volume	17,100
Total	**158,300**
Distribution of Transbasin Diversion in Diamond Fork Creek	
Diamond Fork Creek conveyance volume[c]	37,200
Diamond Fork Pipeline conveyance volume[d]	121,100
Total	**158,300**

[a]For replacement of M&I water pumped from wells and springs in southern Utah County
[b]For exchange to Jordanelle Reservoir for the Bonneville Unit M&I System
[c]In addition to this Strawberry Reservoir water, 15,800 acre-feet of natural flow and 3,300 acre-feet of seepage from Strawberry Tunnel would be conveyed in Diamond Fork Creek.
[d]In addition to this Strawberry Reservoir water, 5,100 acre-feet of natural flow and 300 acre-feet of seepage from Strawberry Tunnel would be conveyed in the Diamond Fork Pipeline.

The transbasin diversion would be made primarily from the Syar Tunnel. The average annual release though Syar Tunnel of 141,200 acre-feet would be released to Sixth Water Creek and conveyed in the creek to Three Forks Reservoir. The rest of the transbasin diversion would be made through the Strawberry Tunnel. The diversion through Strawberry Tunnel would be limited to the flow needed to maintain CUPCA-specified minimum flows in Sixth Water Creek, which are 32 cfs from May through October and 25 cfs during the remainder of the year. These minimum flows require an annual discharge of 20,700 acre-feet from the tunnel. This amount would be provided by a combination of water seeping into the Strawberry Tunnel (3,600 acre-feet annually) and water diverted from Strawberry Reservoir (17,100 acre-feet annually). A schematic of the Diamond Fork System operation under the No Action Alternative is shown in Figure 1-23.

The discharge from Strawberry and Syar Tunnels, combined with the natural flow of Diamond Fork, Sixth Water, and Cottonwood Creeks, would flow into Three Forks Reservoir, located at the confluence of Diamond Fork, Sixth Water, and Cottonwood Creeks. The total inflow to the reservoir would consist of the 158,300 acre-feet of transbasin diversion from Strawberry Reservoir, the Strawberry Tunnel seepage of 3,600 acre-feet, and natural creek flow averaging 20,900 acre-feet annually, for a total reservoir inflow of 182,800 acre-feet.

At Three Forks Dam, an average of 126,500 acre-feet of Bonneville Unit water and natural flow would be released into the Diamond Fork Pipeline and 56,300 acre-feet of Bonneville Unit water and natural flow would be released into Diamond Fork Creek. The flow of the Diamond Fork Pipeline would be conveyed to the confluence of Diamond Fork Creek and the Spanish Fork River, where it would be discharged into the Spanish Fork River. As specified in CUPCA, minimum flows of 60 cfs from October through April and 80 cfs during the remainder of the year would be maintained in Diamond Fork Creek below Monks Hollow.

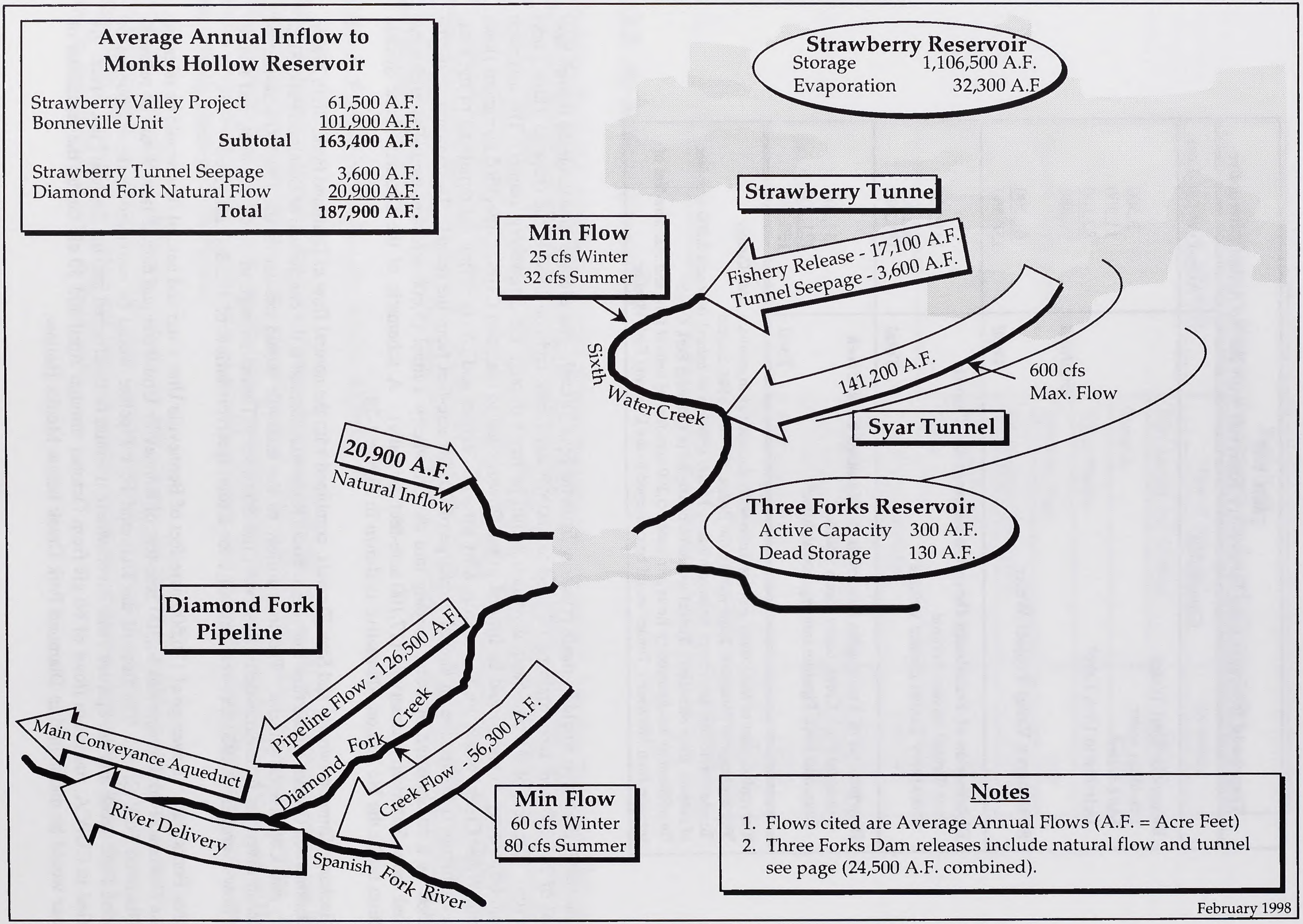


Figure 1-23
Schematic of Diamond Fork System Operation Under the No Action Alternative

1.6.8.1.2 Water Delivery. The 3,500 acre-feet of irrigation water shown in Table 1-49 would be diverted from the Spanish Fork River as a supplemental irrigation supply for the 47,800 acres of presently irrigated lands in the Spanish Fork area. These lands could include non-SWUA lands served by the High Line, East Bench, Salem, South Field, Millrace, and Lake Shore Canals, as well as the Mapleton Lateral. This supplemental irrigation water would be diverted from the Spanish Fork River at existing diversion facilities and conveyed to farms through existing distribution facilities; no new facilities would be constructed. No water would be delivered to Juab County. Lands receiving Bonneville Unit irrigation water that have not already been certified by the Secretary of Interior as being arable would need to be certified before receiving Bonneville Unit irrigation water.

The 11,200 acre-feet of M&I water for the communities of southern Utah County would be pumped from city groundwater wells or developed from springs under the same arrangements described in the Proposed Action. The 11,200 acre-feet of M&I water depleted from groundwater would be replaced in Utah Lake by delivering that amount of water from Strawberry Reservoir to Utah Lake through the Spanish Fork River, forming an exchange as described in the Proposed Action.

The 82,100 acre-feet per year delivered to Utah Lake would be exchanged to Jordanelle Reservoir for use in the Bonneville Unit M&I System. The exchange water would replace Provo River water retained in Jordanelle Reservoir and then diverted for M&I uses in northern Utah and Salt Lake Counties. In the No Action Alternative, however, the amount of water available from Strawberry Reservoir for exchange would be sufficient to compensate for the entire Provo River flow reduction. Consequently, the water rights in Utah Lake acquired by the CUWCD would not be required for exchange to Jordanelle Reservoir and would not be acquired by the United States.

1.6.8.1.3 Streamflows. In Sixth Water Creek, upstream of Sixth Water Aqueduct, the flows would consist of winter releases of 25 cfs and summer releases of 32 cfs from Strawberry Tunnel to maintain minimum flows, plus natural inflow to the creek. The projected flows directly upstream of Sixth Water Aqueduct are shown in Table 1-49a. The table also includes three sets of numbers to describe the flows in various ways. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Below the Sixth Water Aqueduct, the transbasin diversions through Syar Tunnel and Sixth Water Aqueduct are added to the Sixth Water Creek flows. Three sets of numbers are shown in Table 1-49b to describe the flows in various ways. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. In some months during the dry year, the flows are greater than the 44-year average because the 1961 monthly flow distribution pattern varies from the 44-year average flow distribution pattern. Conversely, in some months during the wet year, the flows are lower than the 44-year average because the 1952 monthly flow distribution pattern varies from the 44-year average flow distribution pattern and because "wet" conditions in the agricultural areas during the irrigation season required less water from Strawberry Reservoir than average. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Diamond Fork Creek flows would consist of releases from Three Forks Dam, as shown in Table 1-50. Three sets of numbers are shown to describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year.

Table 1-49a
Streamflows in Sixth Water Creek Above Sixth Water Aqueduct Resulting from the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	27	27	27	28	34	49	40	35	34	34
acre-feet	2,100	1,630	1,660	1,650	1,520	1,710	2,040	2,990	2,370	2,130	2,080	2,020
Representative dry year and wet year monthly average flows (cfs)												
Dry year[b]	34	27	27	27	27	27	28	36	32	32	33	34
Wet Year[c]	35	28	28	27	29	28	59	88	53	37	36	35
Lowest and highest monthly average flows (cfs)												
Lowest[d]	32	26	25	26	26	26	26	33	32	32	32	32
Highest[d]	36	30	30	28	29	31	59	88	68	38	38	38

[a]Rounded to nearest whole cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Table 1-49b
Streamflows in Sixth Water Creek Below Sixth Water Aqueduct Resulting from the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	66	268	279	285	277	250	111	130	264	323	251	236
acre-feet	4,070	15,950	17,170	17,500	15,380	15,370	6,620	8,010	15,710	19,870	15,440	14,020
Representative dry year and wet year monthly average flows (cfs)												
Dry year[b]	55	273	294	276	286	285	248	166	327	223	123	164
Wet Year[c]	55	237	251	269	261	242	80	96	177	308	310	228
Lowest and highest monthly average flows (cfs)												
Lowest[d]	47	175	181	236	208	164	37	45	76	143	95	151
Highest[d]	195	322	342	342	352	343	314	270	413	450	372	371

[a]Rounded to nearest whole cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Table 1-50 Streamflows in Diamond Fork Creek Below Monks Hollow Resulting from the No Action Alternative												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	60	60	60	60	60	60	60	81	130	194	81	80
acre-feet	3,690	3,570	3,690	3,690	3,330	3,690	5,240	8,850	7,620	6,520	4,920	4,760
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	60	60	60	60	60	60	60	80	80	80	80	80
Wet Year[c]	60	60	60	60	60	60	244	395	168	80	80	80
Lowest and highest monthly average flows (cfs)												
Lowest[d]	60	60	60	60	60	60	60	80	80	80	80	80
Highest[d]	60	60	60	60	60	60	244	395	267	174	80	80

[a]Flows over 80 cfs are rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

Flushing flows would be released to Diamond Fork Creek from Three Forks Reservoir by means of Three Forks Dam's overflow spillway and outlet to the creek. The frequency and amounts of such releases would be the same as for the MCAP Alternative.

The upper Spanish Fork River flows would consist of Strawberry Reservoir water and natural flows conveyed in Diamond Fork Creek and the Spanish Fork River. The projected flows of the upper Spanish Fork River under the No Action Alternative are shown in Table 1-51. Three sets of flow numbers describe the flows. The first set of numbers shows the monthly average flows in cfs and acre-feet when averaged over the entire 44-year period of analysis. The second set of numbers shows the monthly average flows from a single extremely dry year and a single extremely wet year. The dry year is based on natural runoff conditions that historically occurred in 1961, and the wet year, the runoff conditions in 1952. The third set of numbers shows the lowest and highest monthly average flows for each month, regardless of the year. The flow rates are considerable higher than under the Proposed Action and the other alternatives because the entire transbasin diversion would be conveyed in the Spanish Fork River.

1.6.8.1.4 Operating Entity. CUWCD would operate and maintain the Diamond Fork System.

1.6.8.1.5 Power Requirements. The No Action Alternative would increase generation at the Spanish Fork Power Plants by approximately 1,428,000 kilowatt-hours per year.

Table 1-51
Streamflows in the Upper Spanish Fork River Resulting from the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges for entire 44-year period of analysis												
cfs[a]	132	334	345	349	354	360	342	505	440	408	336	305
acre-feet	8,130	19,900	21,190	21,470	19,810	22,120	20,320	31,020	26,150	25,060	20,640	18,140
Representative dry year and wet year average monthly flows (cfs)												
Dry year[b]	99	318	334	320	334	342	302	224	247	246	164	209
Wet Year[c]	121	302	314	342	332	348	1,100	1,903	694	524	469	354
Lowest and highest monthly average flows (cfs)												
Lowest[d]	88	301	304	319	278	312	199	207	197	173	139	199
Highest[d]	316	371	388	393	401	423	1,100	1,903	694	539	730	544

[a]Rounded to nearest cfs.
[b]The dry year monthly average flows are represented by 1961 hydrologic conditions.
[c]The wet year monthly average flows are represented by 1952 hydrologic conditions.
[d]The lowest and highest monthly average flows during the 44-year period of analysis.

1.6.8.2 Diamond Fork System Facilities with the No Action Alternative

In the absence of the SFN System, the Diamond Fork System would be completed by the construction of Three Forks Dam and Reservoir and certain additions to the Diamond Fork Pipeline. With the construction of these facilities, the Diamond Fork System would consist of the following facilities:

- Syar Tunnel (existing)
- Sixth Water Aqueduct (existing)[1]
- Three Forks Dam and Reservoir
- Diamond Fork Pipeline Extension to Three Forks Dam
- Diamond Fork Pipeline (existing)
- Diamond Fork Pipeline Extension to the Spanish Fork River

Physical data for the features of the Diamond Fork System under the No Action Alternative are summarized in Table 1-52. The Diamond Fork System facilities that would need to be constructed with the No Action Alternative are described in the following subsections.

[1]In the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990), the aqueduct between the Syar Tunnel and Sixth Water Creek was named the Fifth Water Aqueduct. The name was changed to Sixth Water Aqueduct when the alignment was changed for cost-effectiveness.

Table 1-52 Summary Data for Diamond Fork System Facilities Associated with the No Action Alternative								
Facility	Length (miles)	Diameter (feet)	Height (feet)	Capacity		Surface Area (acres)		Material Volume (cubic yards)
				(cfs)	(acre-feet)	Normal	Minimum	
Syar Tunnel	5.7	8.5	NA	600	NA	NA	NA	NA
Sixth Water Aqueduct								
Sixth Water Pipeline	0.8	8.0	NA	600	NA	NA	NA	NA
Sixth Water Shaft	0.6	8.5	NA	600	NA	NA	NA	NA
Sixth Water Tunnel		8.5	NA	600	NA	NA	NA	NA
Three Forks Dam	NA	NA	60	NA	NA	NA	NA	65,000
Three Forks Reservoir	NA	NA	NA	NA	430	14	8	NA
Diamond Fork Pipeline Extension to Three Forks Dam	2.5	8.0	NA	510	NA	NA	NA	NA
Diamond Fork Pipeline	7.5	8.0	NA	510	NA	NA	NA	NA
Diamond Fork Pipeline Extension to the Spanish Fork River	0.1	8.0	NA	510	NA	NA	NA	NA

1.6.8.2.1 Three Forks Dam and Reservoir. As discussed in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990), the dam would be a 60-foot-high, roller-compacted concrete structure with a crest length of 275 feet. Approximately 65,000 cubic yards of concrete would be used in the dam. The entire crest of the dam would serve as a spillway to safely pass anticipated floods. Two outlet works would be provided. An outlet to the intake of Diamond Fork Pipeline would have a capacity of 510 cfs. The second outlet to Diamond Fork Creek would have a capacity of 250 cfs. Three Forks Reservoir would have a total capacity of 430 acre-feet and, at normal water surface elevation (5,582 feet), a surface area of 14 acres. Diamond Fork Road would be raised from Three Forks to approximately 0.25 mile upstream of Three Forks to locate the road above the Three Forks Reservoir water level. The reservoir could fluctuate 27 feet on a daily basis to regulate daily peak releases from the Sixth Water Aqueduct. The reservoir would have a surface area of 8 acres at minimum pool. Most of the sediment load would be flushed through the reservoir (about 3 percent trap efficiency); however, occasional removal of some bedload material might be required to maintain proper operation.

1.6.8.2.2 Diamond Fork Pipeline Additions. The 96-inch-diameter Diamond Fork Pipeline would require additions at both ends to prepare it for the No Action Alternative operation plan. At the upstream end, the pipeline would be extended approximately 2.5 miles to the outlet of the proposed Three Forks Dam. The extension would be routed along Diamond Fork Canyon Road, which lies on the north side of the creek. The configuration of Diamond Fork Canyon varies along the route, with the first 0.4-mile section (proceeding upstream) through the narrow canyon containing the Monks Hollow Dam site, the next 1.1-mile section along the relatively wide river bottom upstream of Monks Hollow, and the final 1-mile section along the narrower creek bottom as it approaches Three Forks.

At the downstream end of the Diamond Fork Pipeline, a discharge pipeline would be constructed to convey water from the pipeline to the Spanish Fork River. The turnout would be located north (upstream) of the Highway 6 embankment across the mouth of Diamond Fork Creek. The turnout would have an enclosed gate chamber and an 800-foot-long discharge pipeline to convey the released water to Diamond Fork Creek. The discharge pipeline outlet would be designed to avoid stream bank erosion on Diamond Fork Creek by the released water. The

44-year operational analysis of the No Action Alternative indicates that the releases from this turnout would range from less than 10 cfs in October to about 350 cfs in June.

1.6.8.3 Pre-Construction and Construction

Construction of Three Forks Dam and Reservoir, the extension of the Diamond Fork Pipeline, and the turnout would require 38 acres of permanent right-of-way and 33 acres of temporary right-of-way, all in Uinta National Forest. The right-of-way permit would be obtained for Uinta National Forest land in the same manner as described for the Proposed Action. The construction period for the No Action Alternative would begin in October 1999 and end in March 2003. During year 2000, the 2.5-mile pipeline between Three Forks Dam and the Diamond Fork Pipeline would be constructed along Diamond Fork Road upstream of Monks Hollow, and Diamond Fork Canyon Road between Monks Hollow and Three Forks would be prepared for construction use. The construction of Three Forks Dam and Reservoir would take place during 2001 and 2002. During this period, Diamond Fork Road adjacent to Three Forks Dam and Reservoir would be raised, essentially along its present alignment. The turnout at the end of the Diamond Fork Pipeline would be constructed in 2002.

The estimated cost of constructing the No Action Alternative is $30 million, or 10 percent of the cost of the Proposed Action.

1.7 Authorizing Actions, Permits, and Licenses

The construction and operation of the Proposed Action will require various contracts and agreements, which are being negotiated by the CUWCD with federal agencies, local water companies, and cities. The CUWCD will also need to obtain various permits and licenses from state and federal regulatory agencies. This section summarizes these requirements.

The contracts and agreements needed for construction and operation of the SFN System are listed in Table 1-53. The first contract listed, of which there will be several, is the means whereby the DOI would authorize the CUWCD to construct the SFN System, which is fundamentally a federal project subject to federal oversight.

The second item listed in Table 1-53 involves the water operation and operating cost of the Bonneville Unit facilities involved in the combined delivery of SVP and Bonneville Unit water from Strawberry Reservoir. The current delivery of SVP water through Syar Tunnel is covered by the *Contract Among the United States, Central Utah Water Conservancy District, and Strawberry Water Users' Association Relating to the Operation and Maintenance of the Enlarged Strawberry Reservoir and the Related Facilities Jointly Used* (USBR 1991). This contract addresses the interim operation of the enlarged Strawberry Reservoir, Syar Tunnel, and Strawberry Tunnel. In 1991, it was not anticipated that SVP water would be conveyed in the Bonneville Unit aqueduct conveying water to southern Utah County. Moreover, the "Diamond Fork Tunnel Alternative," contained in the Proposed Action and the MCAPW-DFT Alternative, was not anticipated. The 1998 operating contract with SWUA will address these changed conditions and cover water storage and delivery from the enlarged Strawberry Reservoir to Turnout SU6 of the Main Conveyance Aqueduct, the last delivery point for SVP water.

The last agreement listed, between the CUWCD and the DOI, would transfer the ownership of the Main Pipeline of the EJWEP to the SFN System when the EJWEP Main Pipeline is connected to the Main Conveyance Aqueduct as described in Section 1.6.2.3.8. Under this agreement, the CUWCD would be reimbursed for the cost of constructing the Main Pipeline by means of a credit to the local cost share of the SFN System.

The federal, State, and local permits and licenses required for the Proposed Action and alternatives and the agencies or departments that administer them are listed in Table 1-54.

Table 1-53
Contracts and Agreements for the Proposed Action and Other Alternatives
Page 1 of 2

Contract or Agreement	Purpose
Drainage and Minor Construction Contract	To provide federal terms and conditions under which the CUWCD would construct the "Diamond Fork Tunnel Alternative," Main Conveyance Aqueduct pipelines, and associated facilities. There will be an individual contract for each group of facilities.
1998 Operating Contract with SWUA	To establish operating procedures and cost responsibility for the operation and maintenance of the proposed facilities involved in delivery of both SVP and Bonneville Unit water and to adjust the operating procedures of the existing facilities as needed.
Conveyance Contract with the Strawberry High Line Canal Company (MCAPW-DFT, MCAPW, and MCAT Alternatives only)	To provide for conveyance of Bonneville Unit water along certain sections of the High Line Canal for release to local irrigation companies.
M&I Water Contract	To define with municipalities the delivery of M&I water from the SFN System and the repayment of costs allocated to M&I water.
Water Right Adjustment Contracts	To establish the changes in diversion points of water from local streams as needed to facilitate conveyance in the Main Conveyance Aqueduct and utilization of return flows.
Mona Reservoir Storage Contract	To establish the terms and conditions under which the Bonneville Unit water from the Main Conveyance Aqueduct and from return flows will be stored in Mona Reservoir for irrigation use.
Local Agreements for Use of Wells	To establish operating procedures with owners of irrigation wells under which well water will be used to help meet peak summer irrigation demands.
Project Reserve Power Agreements	To establish the terms and conditions of use of CUP power for Bonneville Unit facilities including replacement of energy affected by Bonneville Unit operations.
Water Conservation Credit Contract	To provide for the design and construction of certain distribution systems.
Irrigation Water Contracts	To define with water companies the delivery of irrigation water and the repayment of costs allocated to irrigation
Contract for Transfer of High Line Canal Facilities	To provide for the conversion of certain sections of the High Line Canal to the Main Conveyance Aqueduct (Proposed Action and MCAP Alternative only)
Local Agencies in Utah County	To fund construction of the recreation trail (Proposed Action and MCAP Alternative only)
Mitigation Commission Money Transfer Agreement	To arrange funding transfers needed for construction of conservation and mitigation features
Utah Lake Water Rights Purchase Contract	To provide for the DOI to purchase Utah Lake water rights from CUWCD

Table 1-53
Contracts and Agreements for the Proposed Action and Other Alternatives
Page 2 of 2

Contract or Agreement	Purpose
Cultural Resources Programmatic Agreement	To provide for conservation of any cultural resources encountered during construction
Strawberry-Utah Lake Operating Agreement	To comply with Section 209 of CUPCA
Warranty Deeds	To acquire permanent rights-of-way for SFN System facilities
Easement Agreements	To provide temporary space for construction activities
Operating and Exchange Agreement with EJCWCD, CUWCD, and the DOI	To establish operating procedures for delivery of water to EJCWCD area.
Salt Creek Water Conveyance Agreement with EJCWCD and Nephi Irrigation Company	To cover the terms and conditions under which the Salt Creek facilities would divert Salt Creek water into the Nephi Pipeline of the Main Conveyance Aqueduct for delivery at aqueduct turnouts.
Main Pipeline Transfer Agreement with the DOI	To cover the terms and conditions under which the Main Pipeline of the EJWEP would be transferred to the SFN System.

Table 1-54
Permits and Approvals Required for the Proposed Action and Other Alternatives
Page 1 of 3

Agency/Department	Permit/Approval	Required For
Federal Agencies		
Army Corps of Engineers	General Permit 40/Individual/Nationwide Section 404 Permit (Clean Water Act, 33 USC 1341)	Discharge of dredge/fill into waters of the United States, including wetlands
U.S. Fish and Wildlife Service	Section 7 Consultation, Biological Opinion (Endangered Species Act, 16 USC 1531-1544)	Ensures Endangered Species Act compliance
	Fish and Wildlife Coordination Act	Ensures that fish and wildlife resources receive equal consideration with other environmental values
	Section 205 of CUPCA	Review and approval of contaminants study
USFS	Special use permit, easement, lease (Federal Land Policy and Management Act, 43 USC 1701-1784; 16 USC 522 et seq.)	Construction of tunnels, pipelines, and access roads in the Diamond Fork Drainage
	Cultural resource use permit (16 USC 470 et seq.)	Survey/excavation on USFS-managed lands
	Conditional use permit	Activities on wildlife resources lands
Federal Highway Administration	Encroachment permits (23 USC 109, 116, 123)	Encroachments of federal highway rights-of-way

Table 1-54
Permits and Approvals Required for the Proposed Action and Other Alternatives
Page 2 of 3

Agency/Department	Permit/Approval	Required For
State Agencies		
Utah State Engineer	Water rights filed but not yet approved	Perfecting water rights for operation of the SFN System and changing the place of use for M&I water
Department of Natural Resources, Division of Water Rights	Stream Channel Alteration Permit (Utah Code Annotated Section 73-3-29)	Change in river or stream (includes road or pipeline construction across a streambed)
Department of Natural Resources, Division of Wildlife Resources	Easement	Activities on Department of Natural Resources lands
Department of Environmental Quality, Water Quality Division	General Construction Activity Stormwater Permit	Stormwater discharges associated with construction activity
	401 Certification (Clean Water Act, 33 USC 1341, if the project requires Army Corps of Engineers 404 permit)	Discharge into waters and wetlands (see U.S. Army Corps of Engineers Section 404 Permit)
	Section 402 Permit (Clean Water Act)	Department of Natural Resources, Division of State Lands and Forestry
Utah State Historic Preservation Office	Section 106 Consultation (National Historic Preservation Act, 16 USC 470)	Historic, architectural, archaeological, or cultural characteristics of properties that meet National Register Criteria (State Historic Preservation Officer responsible for administration) Note: Also refer to National Landmarks Program (36 CFR and National Historic Landmarks Program [36 CFR 65])
	Cultural resource use permit (Utah Code Annotated Section 63-18-25)	Surveys or disturbance to archaeological or paleontological sites on state lands
Department of Transportation	Encroachment permit	Encroachments of state highway rights-of-way
Occupational Safety and Health Administration	Construction permit	Worker safety and health
Department of Public Safety Utah Highway Patrol	Transportation Permit (Utah Code Annotated Section 27-12-155)	Transporting overloads
Local Agencies		
County/City Planning Departments Utah County Juab County Cities of Springville, Spanish Fork, Salem, Payson, Santaquin, Mona, and Nephi	Use permit	Activities where use is conditional in a particular zone

Table 1-54
Permits and Approvals Required for the Proposed Action and Other Alternatives
Page 3 of 3

Agency/Department	Permit/Approval	Required For
Utah County Planning Department	Memorandum of Understanding	Operation and maintenance of recreation trail
County/City Public Works Departments Utah County Juab County Cities of Springville, Spanish Fork, Salem, Payson, Santaquin, Mona, and Nephi	Grading permit	Excavation and fill activities
	Road encroachment	Activities within county rights-of-way
	Transportation permit	Transport of overloads on county road rights-of-way
	Building permit	Construction of structures
Other: Railroads & Local Utilities	Encroachment Permit	Encroachments of rights-of-way

1.8 Cumulative Analysis

The NEPA and the Council on Environmental Quality's (CEQ) *Regulations for Implementing the Procedural Provisions of NEPA* (40 CFR Parts 1500-1508) require federal agencies to consider the cumulative impacts of their actions. Cumulative impacts are defined as the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7). The CEQ regulations provide the broad parameters of what is to be considered in the cumulative impact analysis. Cumulative is defined as increasing or enlarging by successive impact. In order to become a cumulative impact, the impact has to occur in the same space (i.e., impact the same resource) or time (i.e., occur at the same time as the impact being caused by the action being proposed for implementation).

The CEQ definition of cumulative impacts as stated above includes past projects. The impacts from past projects (i.e., the Fingerhut Distribution Center, Syar Tunnel, Sixth Water Aqueduct, roadway improvements along Highway 6 associated with the Thistle slide, and the Provo Municipal Airport Runway Improvement Project) have already occurred or are currently occurring. Impacts resulting from the SFN System are measured from a baseline (i.e., existing conditions); therefore, impacts from past projects have been included in the baseline and were not separated from the analysis. As such, past project impacts are not included in the cumulative impact analyses in Chapter 3.

Cumulative impacts are based on net impacts (i.e., impacts left after mitigation had been applied), not gross impacts. If the SFN System would not impact a resource, there would be no potential for cumulative impacts to that resource. Basing the cumulative impact analysis on gross impact would have resulted in a misrepresentation of what the cumulative impact would be.

The following entities were contacted to develop a list of projects with potential cumulative impacts: responsible federal and state agencies (e.g., U.S. Fish and Wildlife Service, USFS, Utah Division of Wildlife Resources, Utah Department of Transportation), SWUA, planning and public works departments of various cities (Springville, Spanish Fork, Salem, Payson, Santaquin, Mona, and Nephi) and counties (Utah and Juab), local utilities, and railroads.

Section 1.8.1 identifies the projects that were not included in the cumulative impact analysis and the reasons for their exclusion. Section 1.8.2 describes projects that have been included in the cumulative analysis. These interrelated projects could combine with the Proposed Action or an alternative to the Proposed Action to create a cumulative impact on the environment. A discussion of the cumulative impacts that these projects may cause in conjunction with the SFN System is presented in each resource section of Chapter 3 of this DEIS.

1.8.1 Projects Not Included in Cumulative Analysis

The following projects were not included in the cumulative impact analysis.

- **Diamond Fork Power Plants.** The impact of these hydroelectric power plants was included in the *Final Supplement to the Final Environmental Impact Statement, Diamond Fork System* (USBR 1990). As discussed in Section 1.5.2, they are not part of the SFN System, and it is not known if they will be developed or by whom. At the time any power plant proposals are brought forward for funding or construction, additional NEPA compliance would be required. Since there are no definite plans or designs at this time, they were not included in the cumulative impact analysis.

- **Uinta National Forest Plans.** The USFS, Spanish Fork Ranger District is in the process of updating its management plans for the Uinta National Forest. These plans are in the very preliminary stages of development, do not provide sufficient detail for analysis, are not set forth in an approved management plan, and are not funded. Therefore, they were not included in the cumulative analysis.

1.8.2 Projects Included in the Cumulative Impact Analysis

The following projects have been evaluated for potential cumulative impacts associated with the SFN System Proposed Action and each of the alternatives. The cumulative impact analysis for each resource topic is presented in Chapter 3 of this document. The level of detail to which a project is analyzed within each resource section is commensurate with the amount of information available for the project, as well as the significance of potential cumulative impacts.

1.8.2.1 Recreation Trail Plans

The Mountainland Association of Governments, in conjunction with Utah Valley communities and other interested parties, has prepared an evaluation of existing and potential non-motorized transportation routes in Utah Valley. In its *Utah Valley Non-Motorized Transportation Plan* (Mountainland Association of Governments 1996), the Mountainland Association of Governments has identified potential trail corridors in the vicinity of the SFN System and has ranked these routes according to their importance as non-motorized transportation routes.

The Mountainland Association of Governments has identified a trail route along the High Line Canal. This trail alignment has been given a "low priority" ranking as an important transportation route. However, the same trail alignment has been identified as a likely component of the proposed Bonneville Shoreline Trail, which would run generally north/south through Utah and Salt Lake Counties, at the base of the Wasatch Range. The proposed 90-mile Bonneville Shoreline Trail has broad community support, but lacks substantive funding for implementation.

1.8.2.2 Nephi City Municipal Airport Expansion

The City of Nephi, along with the State of Utah and the Federal Aviation Administration, has proposed constructing a new runway at the Nephi City Municipal Airport. A *Draft Environmental Assessment* was prepared in 1996.

Under the proposed plan, a new runway would be constructed parallel to the existing runway, and the existing runway would be converted to a taxiway. The new runway would have a maximum length of 7,200 feet. Total land disturbance associated with the project would be an estimated 326.5 acres, 222.5 of which are located within existing airport lands. Some of the lands that could be affected are currently utilized for agricultural production and are eligible to receive Bonneville Unit water.

1.8.2.3 Utah Lake Wetlands Preserve

The Mitigation Commission has received a Finding of No Significant Impacts pursuant to the Final Environmental Assessment prepared for the establishment of a Utah Lake Wetland Preserve. The land and water acquired for the Utah Lake Wetlands Preserve would be managed for the protection of migratory birds, wildlife habitat, and wetland values and would be compatible with surrounding agricultural land uses. Under the Mitigation Commission's Proposed Action, private property would be acquired in the Goshen Bay and Benjamin Slough areas along the southern end of Utah Lake. Approximately 4,041 and 17,754 acres have been identified for preservation within Benjamin Slough and Goshen Bay, respectively. Land acquisitions have taken place and management planning has begun. The Mitigation Commission proposes an aggressive program of wetland expansion and enhancement. The cumulative effect of this will be a general increase in the quality and quantity of wetlands in Utah County.

1.8.2.4 Western Transportation Corridor Expansion (Legacy Project)

The State of Utah and other interested parties are exploring the possible construction of a north-south interstate highway corridor to alleviate through-traffic loads on I-15 along the Wasatch Front. One alternative under consideration has been named the "Legacy Project." The Legacy Project would result in a highway that would connect with I-15 near Nephi in the south and near Ogden at its northern terminus. Near the SFN System and on-farm areas, the corridor would likely pass to the west of Mona Reservoir and Utah Lake. Because of the current preliminary stage of the project, details of the alignment are not yet known. It is reasonable to assume that the highway would consist of four lanes with a potential right-of-way width of approximately 120 feet. Construction of the highway in southern Utah or Juab Counties would not occur for many years.

1.8.2.5 Diamond Fork Creek and Sixth Water Creek Restoration Plans

The Mitigation Commission is preparing preliminary plans for restoration activities along Diamond Fork and Sixth Water Creeks. The Mitigation Commission will be developing plans to enhance cottonwood growth and increase riparian habitat along the stream banks, as well as restore the stream channels of both creeks.

1.8.2.6 Central Valley Water Reuse Project

The Central Valley Water Reclamation Facility, Salt Lake County Water Conservancy District, and the CUWCD have been jointly planning the Central Valley Water Reuse Project. The project would provide facilities to conserve, treat, and reuse wastewater effluent for irrigation needs in Salt Lake County. Preliminary planning has been completed and a number of draft studies have been conducted for use in preparing an EIS. At this time, the project has been put on hold indefinitely.

1.8.3 Projects Incorporated into SFN System Analysis

Various local projects in the SWUA's Distribution Plan and the EJCWCD *Irrigation Development Plan* (EJCWCD 1997) (see Section 1.9) have been identified as reasonably foreseeable and could cause cumulative impacts in conjunction with the Proposed Action or alternatives. These projects have been identified as part of an overall plan to rehabilitate, upgrade, and expand existing irrigation systems in southern Utah and eastern Juab Counties. The upgrades will enable the systems to deliver new and supplemental water from the CUP and provide water conservation. For purposes of this DEIS, it has been determined that the implementation of these improvements relies heavily on the development and implementation of the SFN System and that the impacts from these improvements would be a consequence of implementing the SFN System. Therefore, rather than including these impacts in the cumulative analysis, they were analyzed as a direct impact of the SFN System (see Section 1.9 for a description of these related actions and Chapter 3 for a discussion of their impacts).

1.9 Related Actions (Local Development)

Various local projects would be implemented concurrently with the SFN System, including facilities to distribute Bonneville Unit water from the SFN System to farmlands and cities and to improve agricultural water distribution and use. These local projects could also facilitate the conveyance of non-Bonneville Unit water. Some local facilities already exist, but would be rehabilitated; others would need to be constructed. Rehabilitation and construction of local facilities would not be part of the federally-funded SFN System; they are related actions that would be constructed by local water companies or by individual irrigators. However, they would not be necessary to meet the purposes and needs of the SFN System but could be a consequence of SFN System development. The following facilities could be constructed or rehabilitated to varying degrees:

- Salt Creek Facilities
- Currant Creek Pipeline
- East Juab Water Efficiency Project
- Distribution Systems
    - Mapleton Distribution Pipeline
    - Salem Distribution Pipeline
    - South Field Distribution Pipeline
    - Lateral 20 Distribution Pipeline
    - West Mona Distribution Pipeline
    - North Nephi Distribution System
    - South Nephi Distribution System
- On-Farm Systems

1.9.1 Relationship with the SFN System

The use of local water distribution systems would be necessary to convey Bonneville Unit water from SFN System facilities to farmlands and cities eligible to receive the water. Some would provide the means to coordinate deliveries of local water supplies with Bonneville Unit water for improved water use efficiency. Improvements to irrigation systems within agricultural lands (hereinafter referred to as "on-farm systems") are also anticipated in order to meet the purpose of implementing statutory water conservation measures. The relationship between federal (i.e., the SFN System) and local development are shown in Figure 1-24. Although local development would not be a part of the federally-funded SFN System, it has been considered for NEPA compliance purposes. Information was provided by local entities and irrigators through meetings with CUWCD staff to develop the most likely local development that would occur with the Proposed Action and each alternative. Potential

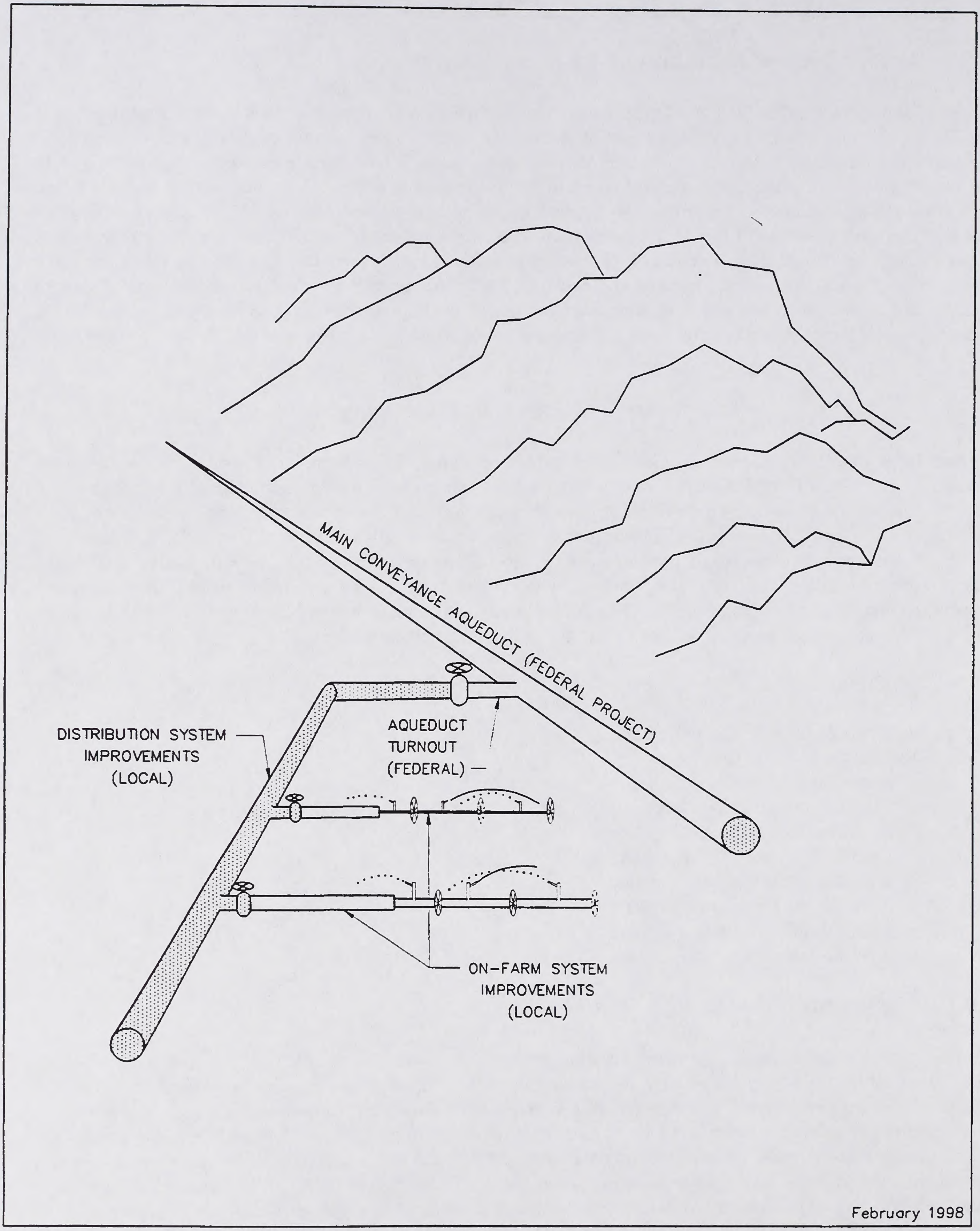


Figure 1-24
Schematic Drawing Showing Jurisdictional Relationship Between Federal and Local Improvements

environmental impacts associated with these local development actions are analyzed in Chapter 3. It is the CUWCD's intent that local entities would be able to use the analysis provided in this document to help acquire approval for the construction and operation of these facilities.

A number of federal and state programs have been implemented to provide financial aid as well as engineering assistance to local farm owners and irrigation districts that choose to develop and apply water conservation measures to new and existing systems. Many of the distribution and irrigation system improvements that would occur as a result of implementing the SFN System would be eligible for federal assistance under these programs. These funding programs include the following:

- Water Conservation Credit Program (CUPCA 207(b))
- Watershed Protection and Flood Prevention Act
- Agricultural Conservation Plan
- Agricultural Resource Development Plan
- Utah State Board of Water Resources Loan Fund

Within southern Utah and eastern Juab Counties, a total of 79,950 acres of agricultural land are eligible to receive Bonneville Unit water. This land has been divided into 11 agricultural land categories (shown on Map 1-11).

1.9.2 General Description of Local Development

The purpose of this section is to identify the types of related actions (i.e., local development of agricultural and M&I water systems that would convey Bonneville Unit water) and the parties responsible for planning and implementing them.

1.9.2.1 M&I Water Distribution

It is anticipated that some water distribution facilities would be modified and/or constructed by communities that receive M&I water in southern Utah County. Such improvements could include the development of secondary water systems. These secondary water systems would deliver non-potable water (water suitable for irrigation, but not for human consumption) that would be used to irrigate lawns and gardens.

Under the Proposed Action and all of the SFN System alternatives, 11,200 acre-feet of Bonneville Unit water would be available for M&I use by cities in southern Utah County. Cities that could receive water include Mapleton, Springville, Elk Ridge, Woodland Hills, Payson, Salem, Santaquin, Spanish Fork, Goshen, and Genola.

Under the Proposed Action and the MCAPW-DFT and No Action Alternatives, M&I water would be obtained by pumping from springs and existing or new local wells. As described in Section 1.6.2.1.3, a groundwater exchange would be utilized to replace these withdrawals with Bonneville Unit water using Utah Lake as the operational interface. The specific locations at which the various cities would obtain this groundwater are not known at this time and would depend on the growth patterns and future water system planning of individual cities. Additional NEPA compliance activities may be required in the future when the locations and annual groundwater pumping amounts have been identified.

Under the MCAP, MCAPW, MCATC, and MCAT Alternatives, Bonneville Unit M&I water would be provided from turnouts along the Main Conveyance Aqueduct.

Local M&I water distribution facilities would be needed to distribute the water to retail customers. Cities in southern Utah County are currently formulating plans to divide and convey the M&I water within their boundaries. Because specific plans for the development of secondary systems in eligible cities are not available at this time, estimates of potential environmental impacts were developed using an M&I Representative Area Template based

on two representative cities, Mapleton and Payson (see Appendix C, *SFN System Municipal and Industrial System Representative Area Template*). The M&I Representative Area Template identifies the assumptions and methods of analysis used to estimate economic and environmental impacts. The information provided in the template was used to estimate impacts associated with the Proposed Action and each of the alternatives, including the No Action Alternative.

1.9.2.2 Irrigation Distribution and On-Farm Systems

1.9.2.2.1 Distribution Systems. For purposes of SFN System planning, irrigation distribution systems would be facilities that transport water from the Main Conveyance Aqueduct or the West Mona Regulating Pond to on-farm facilities (described below). Modifications to existing distribution systems and construction of new distribution systems could result in pressurized pipelines with turnouts to release water to on-farm systems.

Existing distribution facilities in both southern Utah and eastern Juab Counties include irrigation canals and a limited number of pressurized pipelines that distribute water to farms from existing sources, such as the Spanish Fork River, Peteetneet Creek, Summit Creek, and Salt Creek. Canals, laterals, and diversion facilities have been in service in the area since the early 1900s as open, mostly earthen canals. Many of these facilities are in need of repairs and improvements to conserve water lost by seepage and to facilitate more efficient use of water on farms.

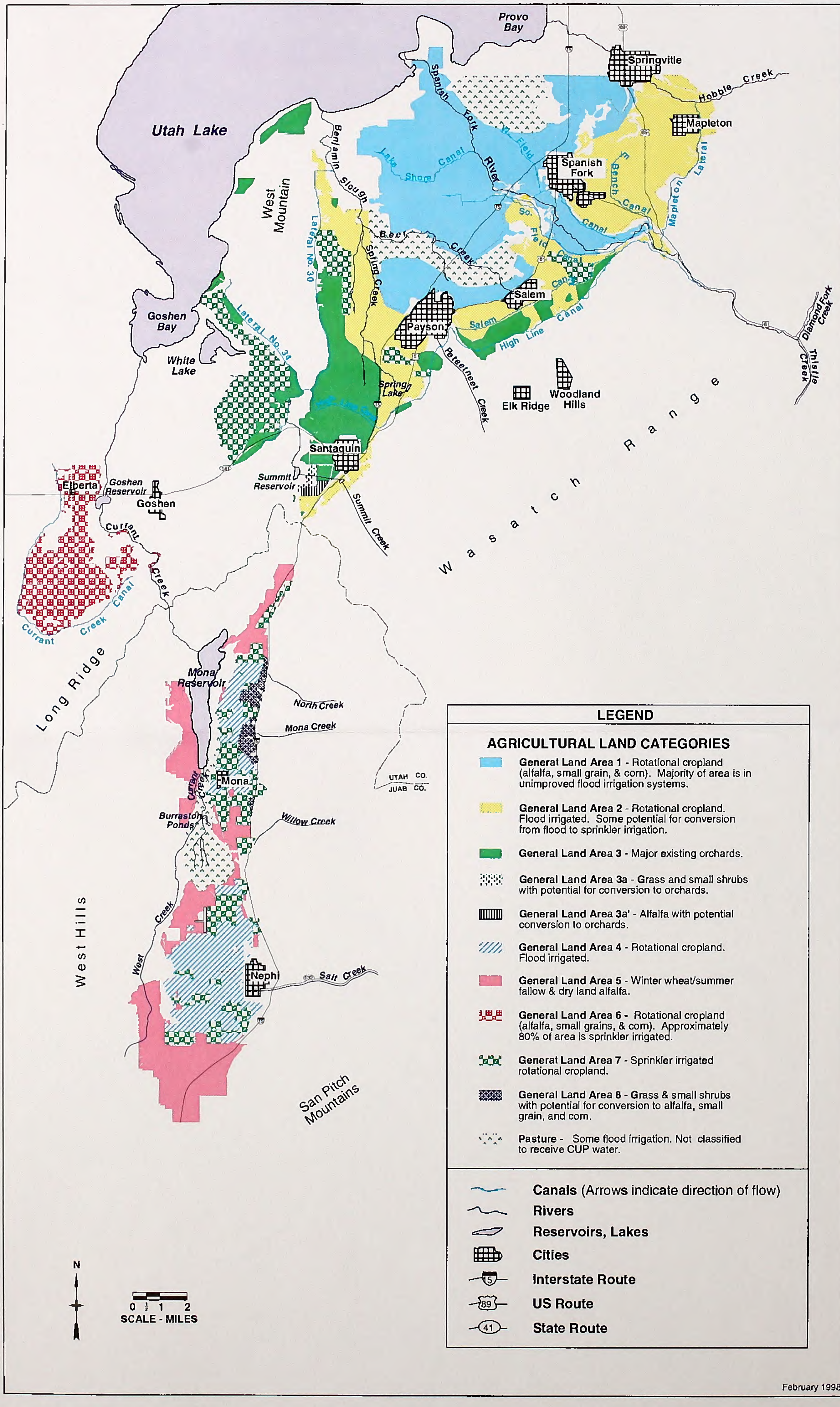
In general, proposed modifications to existing irrigation distribution systems include 1) converting some existing distribution canals to pressurized pipeline systems to accommodate sprinkler irrigation and 2) enlarging these distribution facilities to accommodate the delivery of additional water from the SFN System Main Conveyance Aqueduct. In some cases, new pressurized pipelines would be developed to deliver water from the Main Conveyance Aqueduct.

The SWUA provides engineering services for the majority of the irrigation distribution systems in southern Utah County. The Utah Division of Water Resources is the irrigation distribution system coordinator for eastern Juab County and would prepare the designs for these systems. Implementation would depend on local preference and financing.

1.9.2.2.2 On-Farm Systems. On-farm areas are defined as agricultural lands eligible to receive Bonneville Unit water (see Map 1-11). On-farm irrigation systems would consist of 1) facilities to convey water (e.g., ditches, pipelines, and water control structures) from distribution systems to individual fields and 2) facilities to distribute and apply water more efficiently (e.g., sprinkler systems, head ditches, siphon tubes, gated pipe, and drip irrigation equipment) to various fields. On-farm systems would generally have capacities below 20 cfs. Improvement of on-farm systems would depend on the plans of individual irrigators to upgrade irrigation methods and otherwise improve their on-farm water conveyance facilities and management techniques.

Planning and design of individual on-farm systems would take into consideration the water-holding capacity of the soil, intake rate, depth to the water table, and salt content. On-farm systems would be sized to provide water for crops that have the highest water requirements during the peak demand period. Because each irrigator has a preferred irrigation application method based on his farming enterprise, implementation would depend on the willingness of individual irrigators to finance and upgrade irrigation methods and otherwise improve their on-farm water conveyance facilities and management techniques.

As discussed in Section 1.6.2.1.8, deliveries of existing local surface and groundwater supplies would be coordinated with the SFN System where feasible. Local facilities that would be involved in such coordination would include distribution pipelines, pumping plants, diversion structures, and existing wells.



Map 1-11
Agricultural Lands Eligible to Receive Bonneville Unit Water

1.9.3 Related Actions: Proposed Action

The following sections describe improvements to irrigation distribution and on-farm systems that would likely occur as a result of the Proposed Action.

1.9.3.1 Salt Creek Facilities

The EJCWCD has been organized to develop local water resources and to coordinate the distribution of Bonneville Unit water delivered in Juab County by the SFN System. The EJCWCD would sponsor the construction of the Salt Creek facilities described in this section. The EJCWCD is also cosponsoring, with the CUWCD, the construction of the EJWEP, which is described in Section 1.9.3.3.

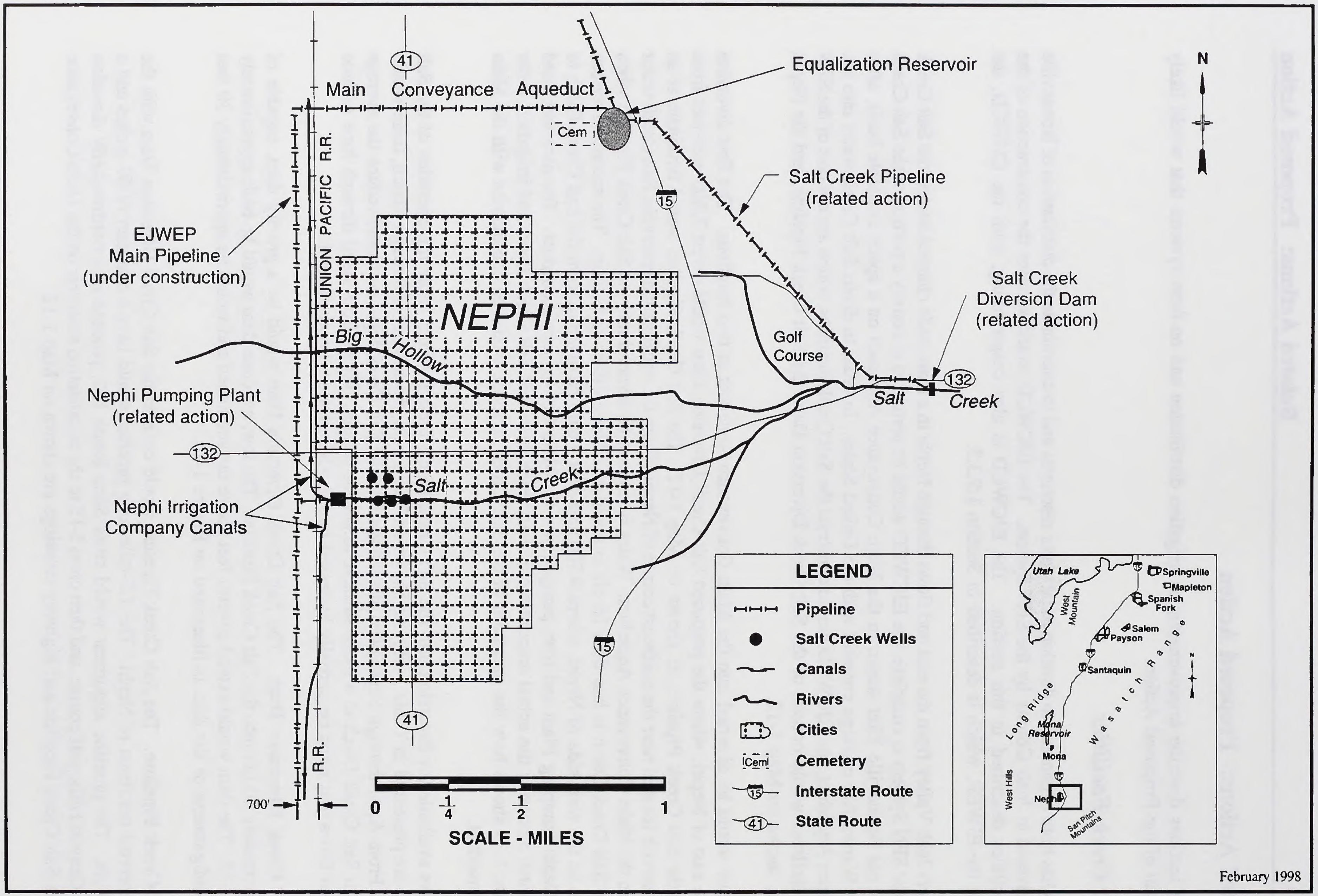
Salt Creek enters Juab Valley from the east and flows through Nephi in a man-made channel named the Salt Creek Ditch. When the SFN System is complete, the EJCWCD would be permitted to convey a portion of the Salt Creek flow, which is not Bonneville Unit water, in the Main Conveyance Aqueduct on a space-available basis, after entering into a Warren Act carriage contract with the United States. In order to divert Salt Creek water into the Main Conveyance Aqueduct, the EJCWCD would construct the Salt Creek facilities, which are not part of the SFN System. The facilities would consist of the Salt Creek Diversion Dam, the Salt Creek Pipeline, and the Nephi Pumping Plant, shown on Map 1-12.

The creek's flow would be diverted into the Main Conveyance Aqueduct at two locations. The first diversion point would be east of Nephi, where the proposed Salt Creek Diversion Dam would divert 7,400 acre-feet from the creek into the Salt Creek Pipeline, as shown on Map 1-12. The Salt Creek Pipeline would terminate at an equalization reservoir located near the northeast corner of Nephi. From the equalization reservoir, Salt Creek water would flow into the Main Conveyance Aqueduct. Water would not be diverted into the Salt Creek Pipeline when the flow in the Salt Creek Ditch is less than 16 cfs to avoid an adverse effect on fishing. The second diversion point would be on the west side of Nephi, where 9,700 acre-feet would be diverted from the Salt Creek Ditch to the proposed Nephi Pumping Plant and then pumped into the Main Conveyance Aqueduct. The acre-feet cited are average annual amounts; the actual amount would vary each year with Salt Creek flows and irrigation water demand. Figure 1-25 shows how the operation of the Salt Creek facilities would be coordinated with the Main Conveyance Aqueduct.

Salt Creek flows available for diversion into the Salt Creek Ditch through Nephi under the operation of the Salt Creek facilities are presented in Table 1-55. As shown on Table 1-55, from October through March, there would be no change. From April through September, diversions into the Salt Creek Pipeline would reduce the average monthly flow in Salt Creek Ditch to a more suitable range for fishing. Flows from April through June include occasional flood flows that must be partially bypassed into the Big Hollow flood channel.

1.9.3.1.1 Salt Creek Diversion Dam. The Salt Creek Diversion Dam would be a gravity dam, capable of diverting approximately 80 cfs into the Salt Creek Pipeline. The low, concrete dam would be built approximately 1 mile east of I-15. The dam would extend several feet above the streambed and would be approximately 30 feet across. The configuration of the dam is illustrated on Figure 1-26.

1.9.3.1.2 Salt Creek Pipeline. The Salt Creek Pipeline would connect the Salt Creek Diversion Dam with the equalization reservoir northeast of Nephi. The 1.5-mile-long pipeline would have a diameter of 60 inches and a capacity of 80 cfs. The pipeline alignment would cross State Route 132, proceed in a northwesterly direction adjacent to the Canyon Hills golf course, and then cross I-15 to the equalization reservoir on the Main Conveyance Aqueduct. The Salt Creek Pipeline and highway crossings are shown on Map 1-12.



Map 1-12
SFN System, Salt Creek Facilities, and EJWEP Main Pipeline near Nephi

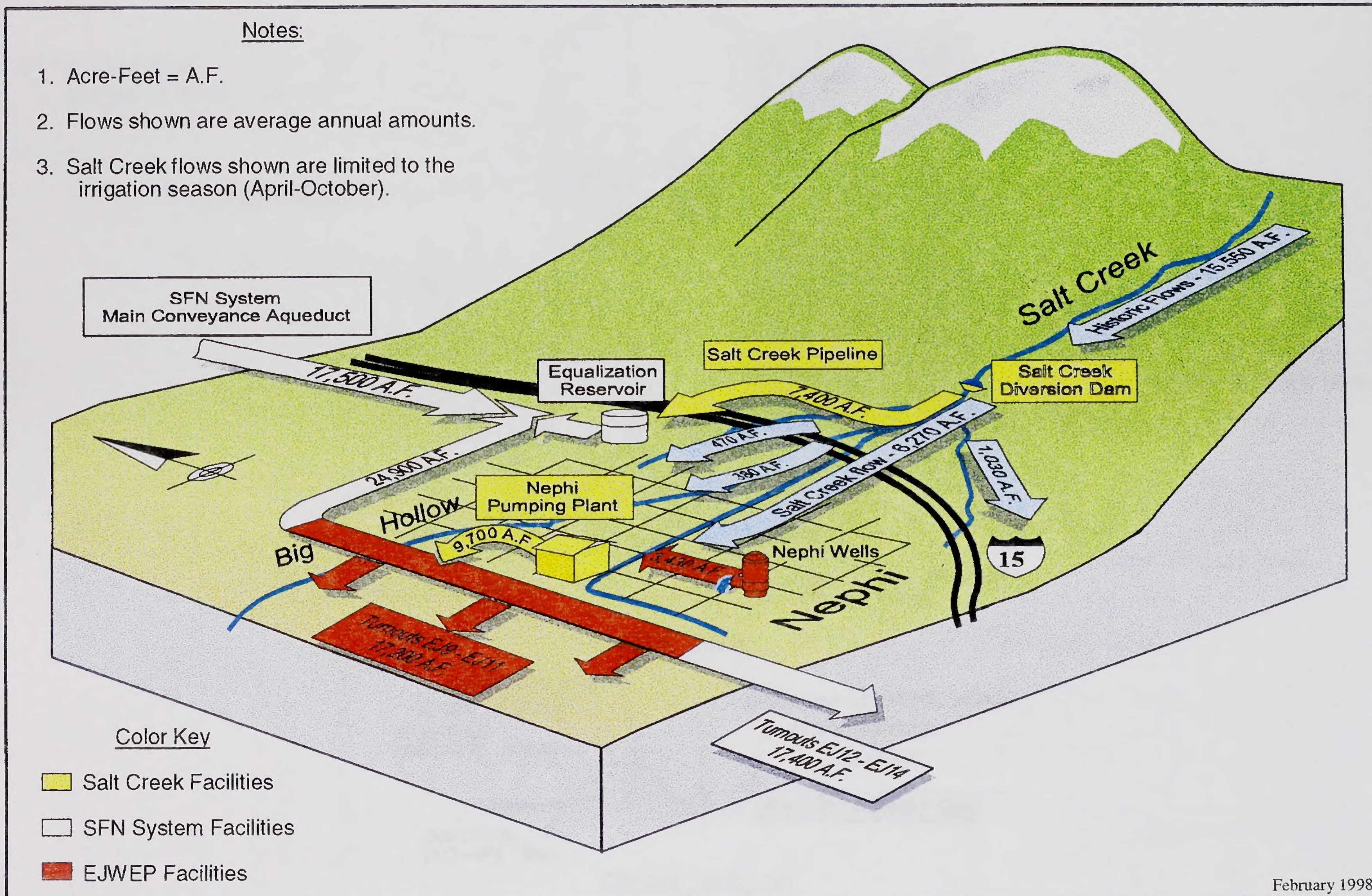


Figure 1-25
Coordination of Salt Creek Facilities, EJWEP, and the SFN System

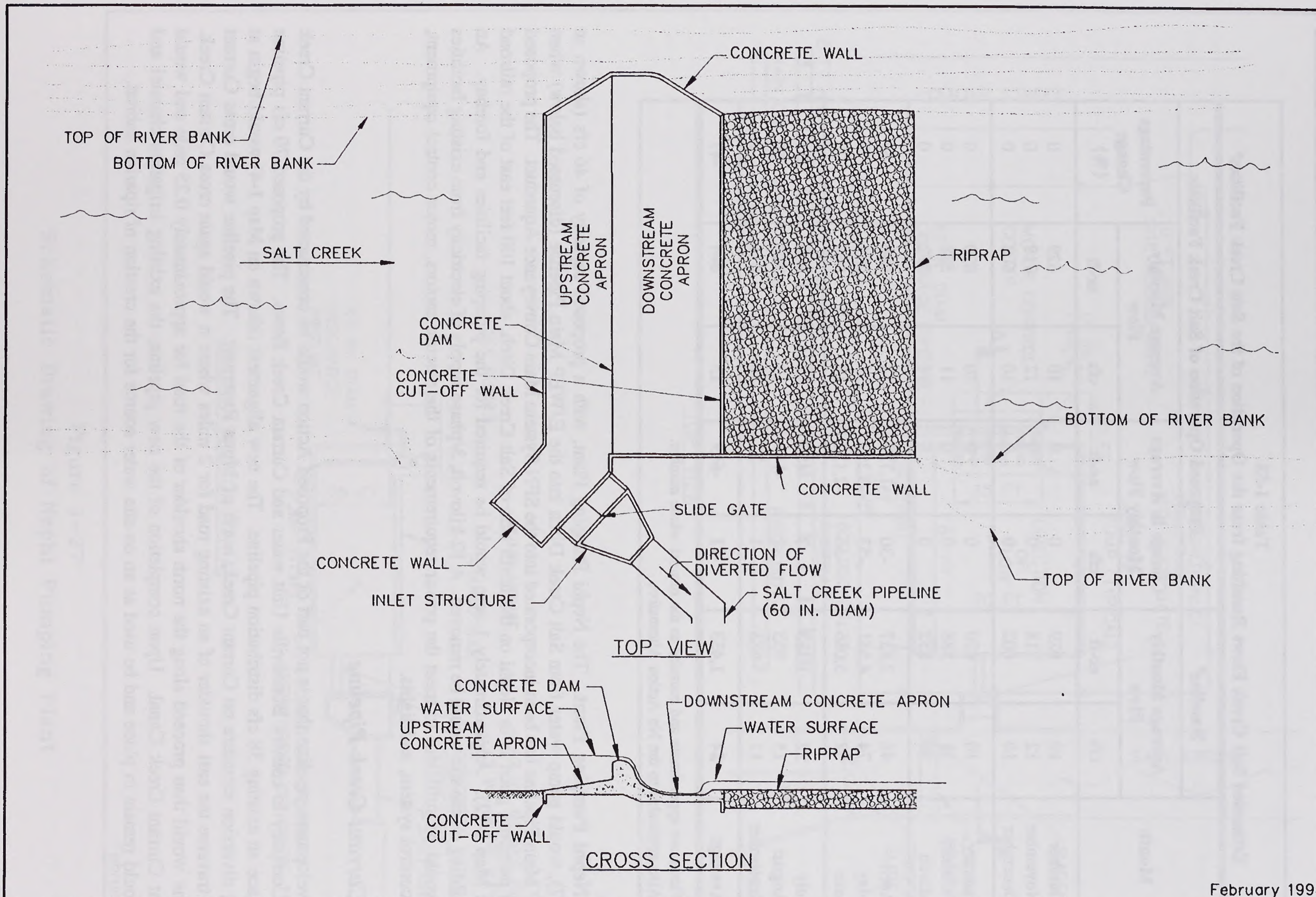


Figure 1-26
Schematic Drawing of Salt Creek Diversion Dam

Table 1-55
Estimated Salt Creek Flows Resulting from the Operation of the Salt Creek Facilities[a]

Month	Baseline[b]		Proposed Operation of Salt Creek Facilities				
	Average Monthly Flow		Change in Average Monthly Flow		Average Monthly Flow		Percentage Change (%)
	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft	
October	10	629	0	0	10	629	0
November	12	718	0	0	12	718	0
December	10	602	0	0	10	602	0
January	10	620	0	0	10	620	0
February	11	588	0	0	11	588	0
March	14	852	0	0	14	852	0
April	48	2,837	-30	-1,757	18	1,080	-67
May	74	4,551	-53	-3,257	21	1,294	-77
June	52	3,086	-36	-2,122	16	964	-70
July	22	1,383	-7	-480	15	903	-35
August	15	933	-2	-149	13	784	-16
September	11	633	-1	-22	10	611	-3
Average	**24**	**1,453**	**-11**	**-649**	**13**	**804**	**-47**

[a]Flows are approximate and rounded to the nearest whole number.
[b]Also applicable to the No Action Alternative.

1.9.3.1.3 Nephi Pumping Plant. The Nephi Pumping Plant, with a proposed capacity of 46 cfs (shown in Figure 1-27), would pump water from Salt Creek Ditch into the EJWEP Main Pipeline (discussed below) when the EJWEP Main Pipeline has been incorporated into the SFN System Main Conveyance Aqueduct. The proposed site for the pumping plant is in Nephi on the north side of Salt Creek Ditch, about 100 feet east of the railroad tracks (see Map 1-12). Approximately 1 acre would be required for the pumping facilities and forebay. An existing building on the site would be removed. A 12-kilovolt, 3-phase supply of electricity from existing facilities in Nephi would be sufficient to meet the power requirements of the electric motors, motor control equipment, automatic control system, and lights.

1.9.3.2 Currant Creek Pipeline

A local development pipeline that is not part of the Proposed Action would be constructed by the Currant Creek Irrigation Company to convey Bonneville Unit water and Currant Creek flows. The proposed 70 cfs pipeline would replace an existing 38 cfs distribution pipeline. The new alignment (shown on Map 1-4) would begin at an existing diversion structure on Currant Creek, north of Mona Reservoir. The pipeline would cross Currant Creek and traverse the east shoulder of an existing road for 2 miles where it would again cross Currant Creek. The pipeline would then proceed along the north shoulder of the road for approximately 0.25 mile and would terminate at Currant Creek Canal. Upon completion of the new pipeline, the existing irrigation channel and pipeline would remain in place and be used as an on-site water source for the creation of riparian habitat.

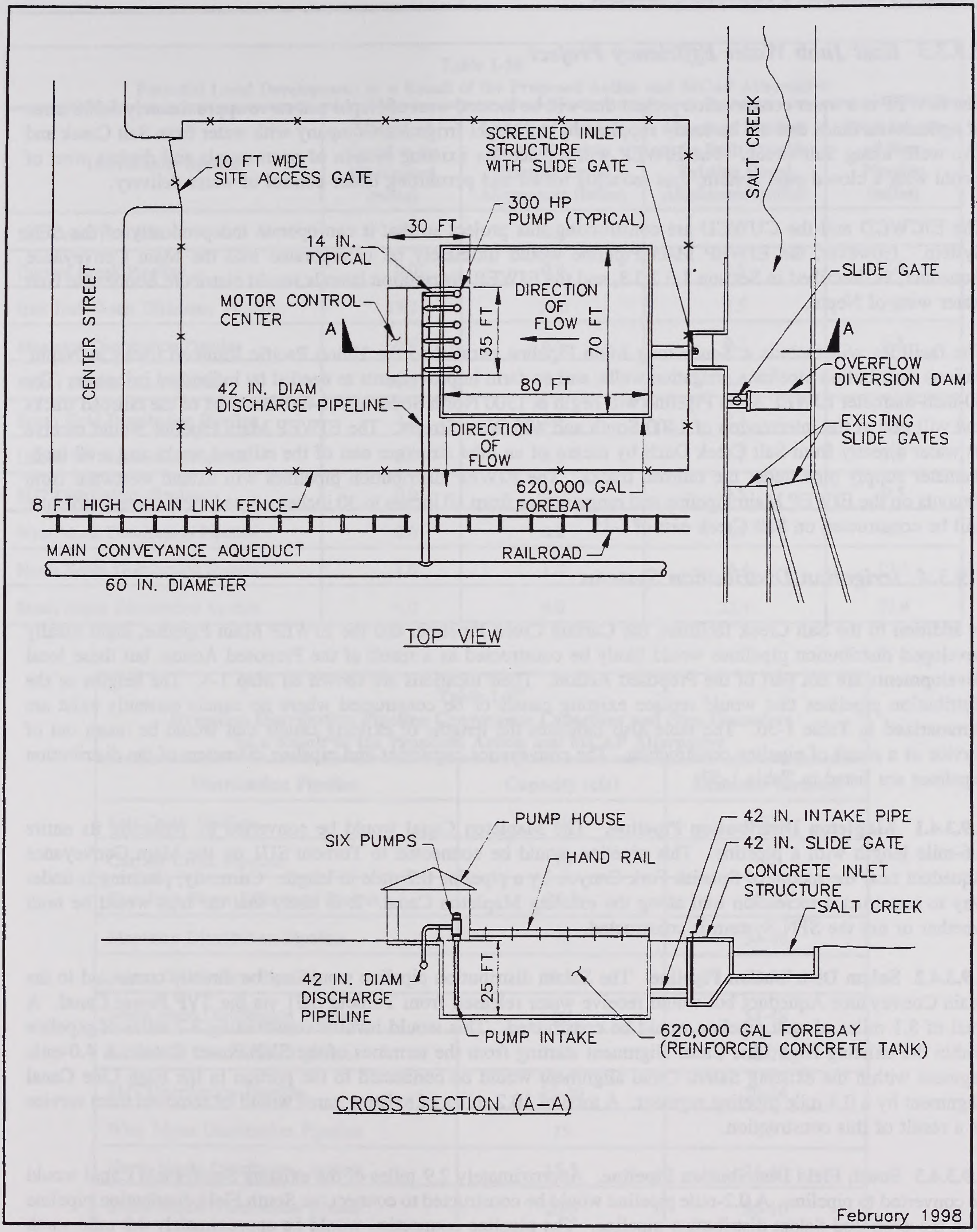


Figure 1-27
Schematic Drawing of Nephi Pumping Plant

1.9.3.3 East Juab Water Efficiency Project

The EJWEP is a water conservation project that will be located west of Nephi and serve approximately 5,300 acres of agricultural lands that are currently supplied by the Nephi Irrigation Company with water from Salt Creek and five wells along Salt Creek. The EJWEP will replace the existing system of open canals and ditches west of Nephi with a closed pipe system, thus reducing losses and permitting better control of water delivery.

The EJCWCD and the CUWCD are constructing this project so that it can operate independently of the SFN System. However, the EJWEP Main Pipeline would ultimately be incorporated into the Main Conveyance Aqueduct, as described in Section 1.6.2.3.8, and the EJWEP distribution laterals would distribute Bonneville Unit water west of Nephi.

The facilities will include a 3-mile-long Main Pipeline parallel to the Union Pacific Railroad tracks at Nephi, various distribution pipelines, irrigation wells, and on-farm improvements as needed by individual irrigators. The 60-inch-diameter EJWEP Main Pipeline will begin at 1500 North Street about 400 feet west of the railroad tracks and will end at the intersection of 1400 South and 400 West Streets. The EJWEP Main Pipeline would receive its water directly from Salt Creek Ditch by means of an inlet structure east of the railroad tracks and a 60-inch-diameter supply pipe under the railroad tracks. The EJWEP distribution pipelines will extend westward from turnouts on the EJWEP Main Pipeline and range in size from 10 inches to 30 inches. A sediment control structure will be constructed on Salt Creek east of I-15.

1.9.3.4 Irrigation Distribution Systems

In addition to the Salt Creek facilities, the Currant Creek Pipeline, and the EJWEP Main Pipeline, eight locally developed distribution pipelines would likely be constructed as a result of the Proposed Action, but these local developments are not part of the Proposed Action. Their locations are shown on Map 1-4. The lengths of the distribution pipelines that would replace existing canals or be constructed where no canals currently exist are summarized in Table 1-56. The table also indicates the lengths of existing canals that would be taken out of service as a result of pipeline construction. The conveyance capacities and pipeline diameters of the distribution pipelines are listed in Table 1-57.

1.9.3.4.1 Mapleton Distribution Pipeline. The Mapleton Canal would be converted by replacing its entire 6.6-mile length with a pipeline. This pipeline would be connected to Turnout SU1 on the Main Conveyance Aqueduct near the mouth of Spanish Fork Canyon by a pipeline 0.2 mile in length. Currently, planning is under way to construct a recreation trail along the existing Mapleton Canal. It is likely that the trail would be built whether or not the SFN System is constructed.

1.9.3.4.2 Salem Distribution Pipeline. The Salem distribution pipeline would not be directly connected to the Main Conveyance Aqueduct but would receive water released from Turnout SU1 via the SVP Power Canal. A total of 8.1 miles of new pipeline would be constructed. This would involve constructing 3.7 miles of pipeline within the existing High Line Canal alignment starting from the terminus of the SVP Power Canal. A 4.0-mile segment within the existing Salem Canal alignment would be connected to the portion in the High Line Canal alignment by a 0.4-mile pipeline segment. A total of 10.2 miles of existing canal would be removed from service as a result of this construction.

1.9.3.4.3 South Field Distribution Pipeline. Approximately 2.9 miles of the existing South Field Canal would be converted to pipeline. A 0.2-mile pipeline would be constructed to connect the South Field distribution pipeline with the proposed Salem distribution pipeline. The pipeline connection would be approximately 0.2 mile south of the current junction of the existing South Field and Salem Canals. Two miles of the western portion of the South Field Canal would remain in service and continue to deliver non-pressurized water.

Table 1-56
Potential Local Development as a Result of the Proposed Action and MCAP Alternative

Distribution System	Length of Canal to be Eliminated (miles)	Length of Pipeline to be Placed in Existing Canal Alignments (miles)	Length of Pipeline to be Built Outside Existing Canal Alignments (miles)	Total Length of New Pipeline (miles)
Salt Creek Facilities	0.0	0.0	1.5	1.5
Currant Creek Pipeline	0.0	0.0	2.5	2.5
East Juab Water Efficiency Project	19.2	19.2	2.5	21.7
Mapleton Distribution Pipeline	6.6	6.6	0.2	6.8
Salem Distribution Pipeline	10.2	7.7	0.4	8.1
South Field Distribution Pipeline	2.9	2.9	0.2	3.1
Lateral 20 Distribution Pipeline	8.5	6.6	1.7	8.3
SU7 Distribution Pipeline	0.0	0.0	0.5	0.5
West Mona Distribution Pipeline	0.0	0.0	4.7	4.7
North Nephi Distribution System	1.0	1.0	11.4	12.4
South Nephi Distribution System	4.0	4.0	23.4	27.4

Table 1-57
Irrigation Distribution Pipeline Conveyance Capacities and Pipe Diameters as a Result of the Proposed Action and MCAP Alternative

Distribution Pipeline	Capacity (cfs)	Diameter (inches)
Salt Creek Pipeline	80	60
Currant Creek Pipeline	70	44
East Juab Water Efficiency Project	25-5	60-10
Mapleton Distribution Pipeline	73	54-48
Salem Distribution Pipeline	50-25	42-30
South Field Distribution Pipeline	80	54-48
Lateral 20 Distribution Pipeline	160	78-72
SU7 Distribution Pipeline	15-10	30-24
West Mona Distribution Pipeline	15	30
North Nephi Distribution System	15-5	24-10
South Nephi Distribution System	20-5	30-10

1.9.3.4.4 Lateral 20 Distribution Pipeline. An 8.3-mile pipeline system would replace the existing 8.5-mile Lateral 20 distribution system. The new pipeline system would connect to the Main Conveyance Aqueduct approximately 0.6 mile south of Payson at Turnout SU5. The alignment of the new system would use 6.6 miles of the present system alignment. The remainder of the present system would be taken out of service, filled with earth, graded, and revegetated.

1.9.3.4.5 SU7 Distribution Pipeline. A pipeline would be constructed beginning at Turnout SU7 on the Main Conveyance Aqueduct. The pipeline would extend west 0.5 mile along the southern edge of Santaquin.

1.9.3.4.6 West Mona Distribution Pipeline. The West Mona distribution pipeline would begin at the West Mona Regulating Pond. From here, the pipeline would run south for 4.7 miles along the east side of lands developed for agriculture, but is currently unirrigated.

1.9.3.4.7 North Nephi Distribution System. Turnouts EJ7 and EJ8 of the proposed Main Conveyance Aqueduct would deliver water for use on approximately 2,880 acres of agricultural land lying directly north of the area to be served by the EJWEP. The North Nephi Distribution System would be a buried pipe system that would distribute irrigation water from Turnouts EJ7 and EJ8. Some of the agricultural land in this area that is eligible to receive Bonneville Unit water currently receives water from Salt Creek (diverted east of Nephi) and from another creek. The system would consist of the conversion of an estimated 1 mile of existing unlined ditch to pipeline and the installation of 11.4 miles of new distribution pipelines.

1.9.3.4.8 South Nephi Distribution System. Turnouts EJ12, EJ13, and EJ14 of the proposed Main Conveyance Aqueduct would deliver water for use on approximately 5,820 acres of agricultural land lying directly south of land to be served by the EJWEP. The South Nephi Distribution System would be a buried pipe system that would distribute irrigation water from Turnouts EJ13 and EJ14. Some of the agricultural land in this area that is eligible to receive Bonneville Unit water currently receives water from Salt Creek; however, most of the area is developed for agriculture but currently unirrigated. The proposed system would consist of the conversion to pipelines of an estimated 4 miles of existing unlined ditches to pipe and the installation of 23.4 miles of new distribution pipelines.

1.9.3.5 On-Farm Systems

As stated previously, the on-farm areas within southern Utah and eastern Juab Counties have been classified into 11 general land areas (see Map 1-11). Ten of the 11 areas are eligible to receive Bonneville Unit water. Anticipated changes in irrigation methods are identified in Section 1.9.2.2.2. In the Mona area, existing on-farm systems would be used to convey up to 4,400 acre-feet of Bonneville Unit water to Mona Reservoir for use in the west Mona area. No on-farm system improvements would be necessary to convey this water to Mona Reservoir.

Because of limited amounts of available Bonneville Unit water, not all eligible farm lands within southern Utah and eastern Juab Counties would be able to receive Bonneville Unit water. Since specific tracts of land that would receive Bonneville Unit water cannot be identified until final water service contracts have been completed, an on-farm methodology was developed to provide a suitable analysis of SFN System impacts. This subsampling approach was adopted to define existing, future-without-SFN System, and future-with-SFN System conditions within the distribution and on-farm areas (CUWCD 1998h). It also defined the parameters to be measured and determined the environmental topic areas for which the approach was suitable. Chapter 3 addresses on-farm-related impacts by resource topic.

1.9.3.6 Pre-Construction Activities

Pre-construction activities for the distribution and on-farm systems would include surveying the proposed rights-of-way and acquiring rights-of-way, as necessary.

1.9.3.6.1 Surveying Activities. Unlike the Main Conveyance Aqueduct and associated features, many of the distribution and on-farm facilities already exist and their rights-of-way have been acquired. Where new facilities would be built, the same procedures identified in Section 1.6.2.8.1 would be followed.

1.9.3.6.2 Right-of-Way Acquisition. Estimated construction and operation right-of-way easement widths for the Proposed Action distribution pipelines are shown in Table 1-58. Because many of these facilities already exist, it is unlikely that new access roads would be necessary. The land required for construction of local development would consist of approximately 394.2 acres of permanent right-of-way and 392.5 acres of temporary right-of-way to provide space for construction activities. Most of the permanent right-of-way easements would be on private land (approximately 78 percent), with the rest distributed among city, county, State, and federal ownership. Most of the temporary right-of-way easements would also be on private land (approximately 72 percent), with the rest distributed among city, county, State, and federal ownership. Where communities and irrigation companies acquire new rights-of-way, landowners would be paid fair market value for rights acquired to their property. Areas of land disturbance that would be associated with local development activities as a result of the Proposed Action are shown in Table 1-59.

Table 1-58
Irrigation Distribution Pipeline Easement Widths Under the Proposed Action and MCAP Alternative

Distribution Pipeline	Permanent (feet)	Temporary* (feet)
Salt Creek Pipeline	60	60
Currant Creek Pipeline	50	50
Mapleton Distribution Pipeline	50	50
Salem Distribution Pipeline	50	50
South Field Distribution Pipeline	40	40
Lateral 20 Distribution Pipeline	60	60
SU7 Distribution Pipeline	40	40
West Mona Distribution Pipeline	60	60
East Juab Water Efficiency Project	20-60	20-60
North Nephi Distribution System	20	20
South Nephi Distribution System	20	20

*Temporary easement width is in addition to the permanent easement width. The temporary easement would be used only during construction.

1.9.3.7 Construction Procedures

1.9.3.7.1 Pipelines. Pipeline construction procedures for the distribution systems would be similar to those identified for the Main Conveyance Aqueduct except that activities and equipment required would be smaller in scale. (See Section 1.6.2.10 for a discussion of pipeline construction procedures.) Construction procedures would include removing the existing concrete lining in the canals and digging trenches for new pipeline. Following pipeline installation, the trench would be backfilled and the surface reseeded in accordance with agreements with landowners. Any canals taken out of service and not used for the pipeline right-of-way would be backfilled, leveled, and revegetated.

Table 1-59
Local Development Land Disturbance
Resulting from the Proposed Action and MCAP Alternative

Project Feature	Areas Disturbed During Construction* (acres)
Salt Creek Facilities	25.0
Currant Creek Pipeline	30.5
Salem Distribution Pipeline	98.2
Mapleton Distribution Pipeline	82.4
South Field Distribution Pipeline	30.1
Lateral 20 Distribution Pipeline	120.7
SU7 Distribution Pipeline	4.8
West Mona Distribution Pipeline	68.4
East Juab Water Efficiency Project	138.6
North Nephi Distribution System	60.0
South Nephi Distribution System	132.8
Total	**791.5**

*All areas disturbed during construction would be reclaimed.

1.9.3.7.2 On-Farm Systems. Local irrigators would be responsible for the design and construction of upgrades to on-farm irrigation systems. Construction and improvement procedures would range from replacing small irrigation canals with pipeline systems to replacing furrow irrigation systems with gated pipe. Construction procedures would vary on individual farms.

1.9.3.8 Operation and Maintenance

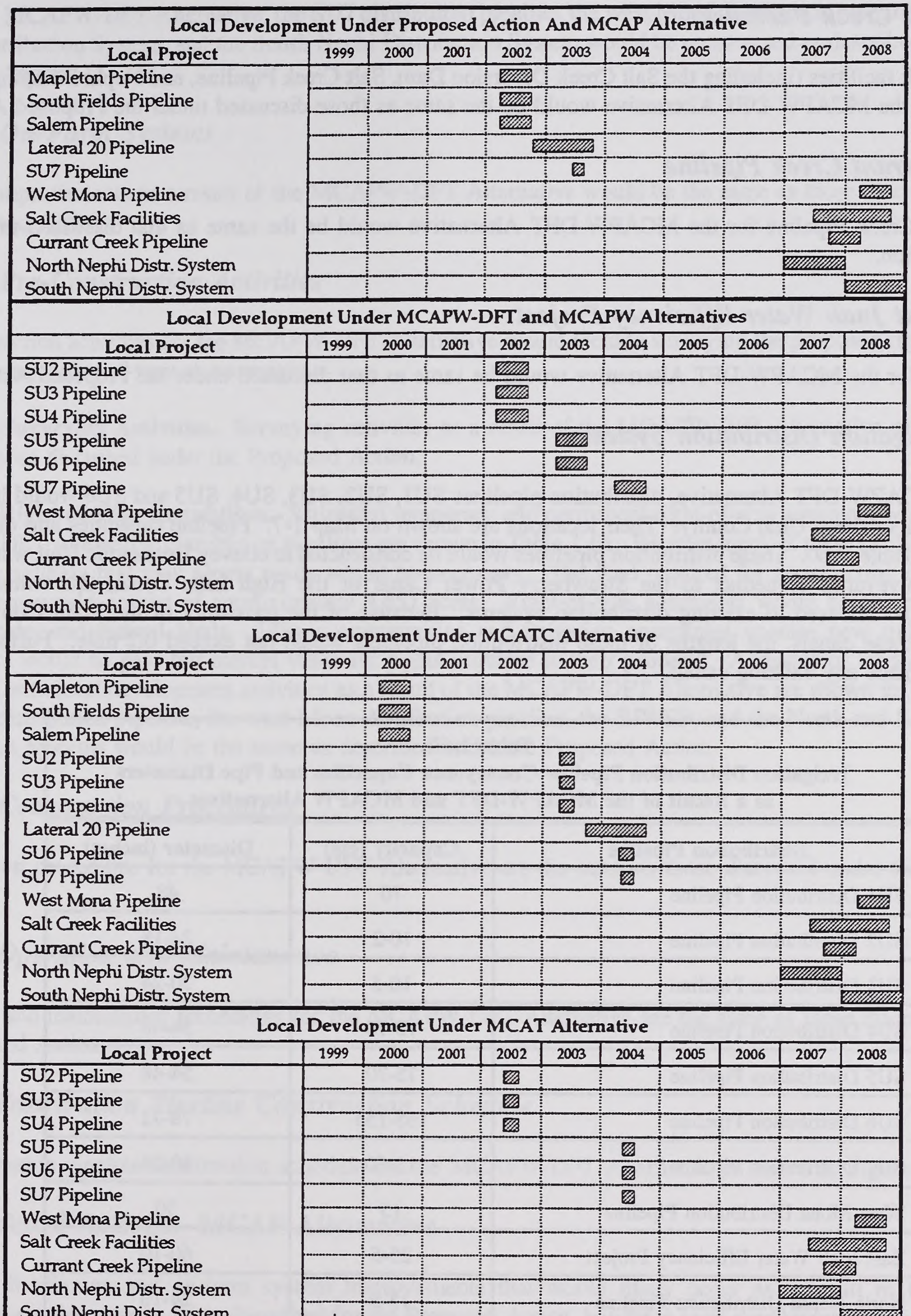
The operation and maintenance of any new water distribution facilities would be the responsibility of irrigation companies or communities building the improvements. In the case of on-farm systems, individual irrigators would be responsible for operating and maintaining the facilities.

1.9.3.9 Distribution Pipeline Construction Schedule

The construction schedule for the distribution systems that would result from the Proposed Action is shown in Figure 1-28.

1.9.4 Related Actions: MCAPW-DFT Alternative

The following sections describe improvements to irrigation distribution and on-farm systems that would likely occur as a result of the MCAPW-DFT Alternative, but these local developments are not part of the MCAPW-DFT Alternative.



Note: Construction of each project will require 10-15 workers per month. February 1998

Figure 1-28
Construction Schedules for Related Actions

1.9.4.1 *Salt Creek Facilities*

The Salt Creek facilities (including the Salt Creek Diversion Dam, Salt Creek Pipeline, and Nephi Pumping Plant) as a result of the MCAPW-DFT Alternative would be the same as those discussed under the Proposed Action.

1.9.4.2 *Currant Creek Pipeline*

The Currant Creek Pipeline for the MCAPW-DFT Alternative would be the same as that discussed under the Proposed Action.

1.9.4.3 *East Juab Water Efficiency Project*

The EJWEP for the MCAPW-DFT Alternative would be same as that discussed under the Proposed Action.

1.9.4.4 *Irrigation Distribution Systems*

Under the MCAPW-DFT Alternative, distribution pipelines SU1, SU2, SU3, SU4, SU5 and SU6 would likely be constructed in southern Utah County. Their locations are shown on Map 1-7. Pipeline capacities and diameters are shown in Table 1-60. These distribution pipelines would be constructed to convey Bonneville Unit water from the Main Conveyance Aqueduct to the Strawberry Power Canal or the High Line Canal; this water would subsequently be released to existing distribution systems. Because of the proximity of the Main Conveyance Aqueduct to these canals, the lengths of these distribution pipelines would not exceed 0.2 mile. Further, they would not replace any existing canals.

Table 1-60
Irrigation Distribution Pipeline Conveyance Capacities and Pipe Diameters as a Result of the MCAPW-DFT and MCAPW Alternatives

Distribution Pipeline	Capacity (cfs)	Diameter (inches)
SU1 Distribution Pipeline	70	48
SU2 Distribution Pipeline	10-2	24-18
SU3 Distribution Pipeline	10-5	30-24
SU4 Distribution Pipeline	75-70	54-48
SU5 Distribution Pipeline	75-70	54-48
SU6 Distribution Pipeline	165-155	78-72
SU7 Distribution Pipeline	15-10	30-24
West Mona Distribution Pipeline	15	30
East Juab Water Efficiency Project	25-5	60-10
North Nephi Distribution Pipeline	15-5	24-10
South Nephi Distribution Pipeline	20-5	30-10

Under the MCAPW-DFT Alternative, the SU7 distribution pipeline, the west Mona distribution pipeline, the North Nephi Distribution System, and the South Nephi Distribution System would be constructed as described under the Proposed Action.

1.9.4.5 On-Farm Systems

On-farm improvements as a result of the MCAPW-DFT Alternative would be the same as those discussed under the Proposed Action.

1.9.4.6 Pre-Construction Activities

Pre-construction activities for the MCAPW-DFT Alternative would include surveying the proposed rights-of-way and acquiring rights-of-way as necessary.

1.9.4.6.1 Surveying Activities. Surveying activities as a result of the MCAPW-DFT Alternative would be the same as those discussed under the Proposed Action.

1.9.4.6.2 Right-of-Way Acquisition. Estimated temporary and permanent right-of-way easement widths for the MCAPW-DFT Alternative distribution pipelines are shown in Table 1-61. Because many of these facilities already exist, it is unlikely that new access roads would be necessary. The land required for construction of the local development would consist of approximately 4,651 acres. Right-of-way easements would be on private, city, county, State, and federal lands. Where communities and irrigation companies acquire new rights-of-way, landowners would be paid fair market value for rights acquired to their property. Acreages of land disturbance associated with local development activities as a result of the MCAPW-DFT Alternative are shown in Table 1-62. The SU7 distribution pipeline, the west Mona distribution pipeline, the EJWEP, and the North and South Nephi Distribution Systems would be the same as described under the Proposed Action.

1.9.4.7 Construction Procedures

Construction procedures for the MCAPW-DFT Alternative are the same as those discussed under the Proposed Action.

1.9.4.8 Operation and Maintenance

Operation and maintenance procedures for the MCAPW-DFT Alternative are the same as those discussed under the Proposed Action.

1.9.4.9 Distribution Pipeline Construction Schedule

The distribution pipeline construction schedule for the MCAPW-DFT Alternative is shown in Figure 1-28.

1.9.5 Related Actions: MCAP Alternative

Irrigation distribution and on-farm system improvements that would likely occur as a result of the MCAP Alternative are the same as those described for the Proposed Action, but these local developments are not part of the MCAP Alternative.

Table 1-61 Irrigation Distribution Pipeline Easement Widths for the MCAPW-DFT and MCAPW Alternatives		
Distribution Pipeline	**Permanent (feet)**	**Temporary* (feet)**
SU1 Distribution Pipeline	50	50
SU2 Distribution Pipeline	40	40
SU3 Distribution Pipeline	40	40
SU4 Distribution Pipeline	50	50
SU5 Distribution Pipeline	50	50
SU6 Distribution Pipeline	60	60
SU7 Distribution Pipeline	40	40
West Mona Distribution Pipeline	60	60
East Juab Water Efficiency Project	20-60	20-60
North Nephi Distribution System	20	20
South Nephi Distribution System	20	20
Salt Creek Pipeline	60	60
Currant Creek Pipeline	50	50
*Temporary easement width is in addition to the permanent easement width. The temporary easement will be used only during construction.		

Table 1-62 Local Development Land Disturbance Resulting from the MCAPW-DFT and MCAPW Alternatives	
Project Feature	**Areas Disturbed During Construction* (acres)**
SU1 Distribution Pipeline	2.4
SU2 Distribution Pipeline	1.0
SU3 Distribution Pipeline	1.0
SU4 Distribution Pipeline	1.0
SU5 Distribution Pipeline	1.0
SU6 Distribution Pipeline	1.0
SU7 Distribution Pipeline	4.8
West Mona Distribution Pipeline	68.4
East Juab Water Efficiency Project	138.6
North Nephi Distribution System	60.0
South Nephi Distribution System	132.8
Salt Creek Facilities	25.0
Currant Creek Pipeline	30.5
Total	**467.5**
*All areas disturbed during construction would be reclaimed.	

1.9.6 Related Actions: MCAPW Alternative

Irrigation distribution and on-farm system improvements that would likely occur as a result of the MCAPW Alternative are the same as those described for the MCAPW-DFT Alternative, but these local developments are not part of the MCAPW Alternative.

1.9.7 Related Actions: MCATC Alternative

The following sections describe improvements to existing irrigation systems that would likely occur as a result of the MCATC Alternative, but these local developments are not part of the MCATC Alternative.

1.9.7.1 Salt Creek Facilities

The Salt Creek facilities (including the Salt Creek Diversion Dam, Salt Creek Pipeline, and Nephi Pumping Plant) as a result of the MCATC Alternative would be the same as those discussed under the Proposed Action.

1.9.7.2 Currant Creek Pipeline

The Currant Creek Pipeline for the MCATC Alternative would be the same as that discussed under the Proposed Action.

1.9.7.3 East Juab Water Efficiency Project

The EJWEP would be constructed as described under the Proposed Action.

1.9.7.4 Irrigation Distribution Systems

Thirteen distribution pipelines would likely be constructed as a result of the MCATC Alternative. Locations of these pipelines are shown on Map 1-9. The lengths of the distribution pipelines that would replace existing canals or that would be constructed where no canals currently exist are summarized in Table 1-63. The table also indicates the lengths of existing canals that would be taken out of service as a result of pipeline construction. The conveyance capacities and diameters of the distribution pipelines are listed in Table 1-64.

As a result of the MCATC Alternative, the SU7 distribution pipeline, the west Mona distribution pipeline, the North Nephi Distribution System, and the South Nephi Distribution System would be constructed as described under the Proposed Action.

1.9.7.4.1 Mapleton Distribution Pipeline. In addition to the Mapleton distribution pipeline described in the Proposed Action, a 3.8-mile-long pipeline would be constructed through Spanish Fork Canyon to connect the proposed Mapleton distribution pipeline to the Main Conveyance Aqueduct at Turnout SU1 near the mouth of Pole Canyon. The route of the pipeline through Spanish Fork Canyon would be the same as the route identified for the Main Conveyance Aqueduct under the Proposed Action.

1.9.7.4.2 SU2 Distribution Pipeline. A 0.9-mile pipeline would extend from Turnout SU2 on the Main Conveyance Aqueduct to the High Line Canal alignment. The pipeline would continue along the High Line Canal alignment, replacing 1.8 miles of the canal. A total of 2.7 miles of new pipeline would be built.

Table 1-63
Potential Local Distribution Systems as a Result of the MCATC Alternative

Distribution System	Length of Canal to be Eliminated (miles)	Length of Pipeline to be Placed in Existing Canal Alignments (miles)	Length of Pipeline to be Built Outside Existing Canal Alignments (miles)	Total Length of New Pipeline (miles)
Mapleton Distribution Pipeline	5.7	5.7	3.9	9.6
Salem Distribution Pipeline	10.2	7.7	0.4	8.1
South Field Distribution Pipeline	2.9	2.9	0.2	3.1
SU2 Distribution Pipeline	1.8	1.8	0.9	2.7
SU3 Distribution Pipeline	1.6	1.6	0.9	2.5
SU4 Distribution Pipeline	1.0	1.0	0.7	1.7
Lateral 20 with Payson Spur	10.2	9.0	0.6	9.6
SU6 Distribution Pipeline	0.0	0.0	0.3	0.3
SU7 Distribution Pipeline	0.0	0.0	0.5	0.5
West Mona Distribution Pipeline	0.0	0.0	4.7	4.7
East Juab Water Efficiency Project	19.2	19.2	2.5	21.7
North Nephi Distribution System	1.0	1.0	11.4	12.4
South Nephi Distribution System	4.0	4.0	23.4	27.4

Table 1-64
Irrigation Distribution Pipeline Conveyance Pipe Capacities and Diameters as a Result of the MCATC Alternative

Distribution System	Capacity (cfs)	Diameter (inches)
Mapleton Distribution Pipeline	73	54-48
Salem Distribution Pipeline	50-25	42-30
South Field Distribution Pipeline	80	54-48
SU2 Distribution Pipeline	10-2	24-18
SU3 Distribution Pipeline	10-5	30-24
SU4 Distribution Pipeline	75-70	54-48
Lateral 20 including Payson Spur	160	78-72
SU6 Distribution Pipeline	165-155	78-72
SU7 Distribution Pipeline	15-10	30-24
West Mona Distribution Pipeline	15	30
East Juab Water Efficiency Project	25-5	60-10
North Nephi Distribution System	15-5	24-10
South Nephi Distribution System	20-5	30-10
Salt Creek Pipeline	60	60
Currant Creek Pipeline	50	50

1.9.7.4.3 SU3 Distribution Pipeline. A 0.9-mile pipeline would extend from Turnout SU3 on the Main Conveyance Aqueduct to the High Line Canal alignment. The pipeline would continue along the High Line Canal alignment and would replace 1.6 miles of the canal. A total of 2.5 miles of new pipeline would be built.

1.9.7.4.4 SU4 Distribution Pipeline. A 0.7-mile pipeline would extend from Turnout SU4 on the Main Conveyance Aqueduct to the High Line Canal alignment. The pipeline would continue along the High Line Canal alignment and would replace 1.0 mile of the canal. A total of 1.7 miles of new pipeline would be built.

1.9.7.4.5 Lateral 20 Distribution Pipeline. As a result of the MCATC Alternative, the Lateral 20 distribution pipeline would replace 8.5 miles of canal (Lateral 20) with 8.3 miles of pipeline, as described for the Proposed Action, and would connect to the Main Conveyance Aqueduct at Turnout SU5 via a 0.6-mile pipeline. In addition to this pipeline, a pipeline (Payson Spur) would be constructed within the High Line Canal alignment and would run north 0.7 mile, ending near Peteetneet Creek. The Payson Spur would replace 0.7 mile of the High Line Canal and eliminate the need for 1.0 mile of the High Line Canal located east (upstream) of Payson. This 1.0-mile segment of the canal would be dewatered, filled, and revegetated. Under this alternative, a total of 10.7 miles of new pipeline would be built.

1.9.7.4.6 SU6 Distribution Pipeline. A pipeline would be constructed from Turnout SU6 on the Main Conveyance Aqueduct to the High Line Canal. This new pipeline would run northwest 0.3 mile and would provide water deliveries to the western segment of the High Line Canal.

1.9.7.5 On-Farm Systems

On-farm improvements as a result of the MCATC Alternative would be the same as those discussed under the Proposed Action.

1.9.7.6 Pre-Construction Activities

Pre-construction activities for the MCATC Alternative would include surveying the proposed rights-of-way and acquiring rights-of-way as necessary.

1.9.7.6.1 Surveying Activities. Surveying activities as a result of the MCATC Alternative would be the same as those discussed under the Proposed Action.

1.9.7.6.2 Right-of-Way Acquisition. Estimated temporary and permanent right-of-way easement widths for the MCAT Alternative distribution pipelines are shown in Table 1-65. Because many of these facilities already exist, it is unlikely that new access roads would be necessary. The land required for construction of the local development would consist of approximately 786.4 acres. Right-of-way easements would be on private, city, county, State, and federal lands. Where communities and irrigation companies acquire new rights-of-way, landowners would be paid fair market value for rights acquired to their property. Acreages of land disturbance associated with local development activities that would result from the MCATC Alternative are shown in Table 1-66.

1.9.7.7 Construction Procedures

Construction procedures for the MCATC Alternative would be the same as those identified for the Proposed Action.

Table 1-65 Irrigation Distribution Pipeline Easement Widths Resulting from the MCATC Alternative		
Distribution Systems	**Permanent (feet)**	**Temporary* (feet)**
Mapleton Distribution Pipeline	50	50
Salem Distribution Pipeline	50	50
South Field Distribution Pipeline	40	40
SU2 Distribution Pipeline	40	40
SU3 Distribution Pipeline	40	40
SU4 Distribution Pipeline	50	50
Lateral 20 including Payson Spur	60	60
SU6 Distribution Pipeline	60	60
SU7 Distribution Pipeline	40	40
West Mona Distribution Pipeline	60	60
East Juab Water Efficiency Project	20-60	20-60
North Nephi Distribution System	20	20
South Nephi Distribution System	20	20
Salt Creek Pipeline	60	60
Currant Creek Pipeline	50	50
*Temporary easement width is in addition to the permanent easement width and will be used only during construction.		

Table 1-66 Local Development Land Disturbance Resulting from the MCATC Alternative	
Distribution System	**Areas Disturbed During Construction* (acres)**
Salem Distribution Pipeline	77.3
Mapleton Distribution Pipeline	116.3
South Field Distribution Pipeline	30.1
Lateral 20 Distribution Pipeline	155.6
SU2 Distribution Pipeline	26.2
SU3 Distribution Pipeline	24.2
SU4 Distribution Pipeline	20.6
SU6 Distribution Pipeline	4.4
SU7 Distribution Pipeline	4.8
West Mona Distribution Pipeline	68.4
East Juab Water Efficiency Project	138.6
North Nephi Distribution System	60.0
South Nephi Distribution System	132.8
Salt Creek Facilities	25.0
Currant Creek Pipeline	30.5
Total Acres	**914.8**
*All areas disturbed during construction would be reclaimed.	

1.9.7.8 Operation and Maintenance

Operation and maintenance procedures for the MCATC Alternative would be the same as described under the Proposed Action.

1.9.7.9 Distribution Pipeline Construction Schedule

The distribution pipeline construction schedule for the MCATC Alternative is shown in Figure 1-28.

1.9.8 Related Actions: MCAT Alternative

The following section describes local development improvements to existing irrigation distribution and on-farm systems that would likely occur as a result of the MCAT Alternative, but these local developments are not part of the MCAT Alternative.

1.9.8.1 Salt Creek Facilities

The Salt Creek facilities (including the Salt Creek Diversion Dam, Salt Creek Pipeline, and Nephi Pumping Plant) as a result of the MCAT Alternative would be the same as those discussed under the Proposed Action.

1.9.8.2 Currant Creek Pipeline

The Currant Creek Pipeline for the MCAT Alternative would be the same as that discussed under the Proposed Action.

1.9.8.3 East Juab Water Efficiency Project

The EJWEP would be constructed as described under the Proposed Action.

1.9.8.4 Irrigation Distribution Systems

Ten distribution systems would likely be constructed as a result of the MCAT Alternative. The distribution systems under the MCAT Alternative would not be as extensive as under the Proposed Action or the MCATC Alternative because under this alternative, SWUA water would not be delivered through the SFN System. Distribution pipelines would be used to deliver supplemental water to the High Line Canal in southern Utah County and to on-farm areas in eastern Juab County. However, neither the High Line Canal nor any of the other existing canals would be replaced with pipeline to deliver Bonneville Unit water from the Main Conveyance Aqueduct. Locations of the distribution pipelines that would likely be constructed as a result of the MCAT Alternative are identified on Map 1-10. The MCAT Alternative distribution pipeline lengths are shown in Table 1-67. The conveyance capacities and diameters of the MCAT Alternative distribution pipelines are listed in Table 1-68.

As a result of the MCAT Alternative, the SU7 distribution pipeline, the west Mona distribution pipeline, the North Nephi Distribution System and the South Nephi Distribution System would be constructed as described under the Proposed Action.

Table 1-67 Potential Local Distribution Systems as a Result of the MCAT Alternative	
Distribution Pipeline	**Total Length of New Pipeline (miles)**
SU2	0.9
SU3	0.9
SU4	0.7
SU5	0.6
SU6	0.3
SU7	0.5
West Mona	4.7
East Juab Water Efficiency Project	21.7
North Nephi Distribution System	12.4
South Nephi Distribution System	27.4

Table 1-68 Distribution Pipeline Conveyance Capacities and Diameters as a Result of the MCAT Alternative		
Distribution Pipeline	**Capacity (cfs)**	**Diameter (inches)**
SU2	10-2	24-18
SU3	10-5	30-24
SU4	75-70	54-48
SU5	75-70	54-48
SU6	165-155	78-72

1.9.8.4.1 SU2 Distribution Pipeline. A 0.9-mile pipeline would be constructed at Turnout SU2 to connect the Main Conveyance Aqueduct to the existing High Line Canal. Bonneville Unit water would be released at this point into the High Line Canal.

1.9.8.4.2 SU3 Distribution Pipeline. A 0.9-mile pipeline would be constructed at Turnout SU3 to connect the Main Conveyance Aqueduct to the existing High Line Canal. Bonneville Unit water would be released at this point into the High Line Canal.

1.9.8.4.3 SU4 Distribution Pipeline. A 0.7-mile pipeline would be constructed at Turnout SU4 to connect the Main Conveyance Aqueduct to the existing High Line Canal. Bonneville Unit water would be released at this point into the High Line Canal.

1.9.8.4.4 SU5 Distribution Pipeline. A 0.6-mile pipeline would be constructed at Turnout SU5 to connect the Main Conveyance Aqueduct to the existing High Line Canal. Bonneville Unit water would be released at this point into the High Line Canal.

1.9.8.4.5 SU6 Distribution Pipeline. A pipeline would be constructed from Turnout SU6 on the Main Conveyance Aqueduct to the High Line Canal. This new pipeline would run northwest 0.3 mile and would provide water deliveries to the western segment of the High Line Canal.

1.9.8.5 On-Farm Systems

On-farm improvements built as a result of the MCAT Alternative would be similar to those discussed under the Proposed Action.

1.9.8.6 Pre-Construction Activities

Pre-construction activities for the MCAT Alternative would include surveying the proposed rights-of-way and acquiring rights-of-way as necessary.

1.9.8.6.1 Surveying Activities. Surveying activities as a result of the MCAT Alternative would be the same as those discussed under the Proposed Action.

1.9.8.6.2 Right-of-Way Acquisition. Estimated temporary and permanent right-of-way easement widths for the MCAT Alternative distribution pipeline are shown in Table 1-69. Because many of these facilities already exist, it is unlikely that new access roads would be necessary. The land required for construction of the local development would consist of approximately 497.7 acres. Right-of-way easements would be on private, city, county, State, and federal lands. Where communities and irrigation companies acquire new rights-of-way, landowners would be paid fair market value for rights acquired to their property. Acreages of land disturbance associated with related actions (local development) activities as a result of the MCAT Alternative are indicated in Table 1-70.

Table 1-69
Irrigation Distribution Pipeline Easement Widths
as a Result of the MCAT Alternative

Distribution Pipeline	Permanent (feet)	Temporary* (feet)
SU2	40	40
SU3	40	40
SU4	50	50
SU5	50	50
SU6	60	60

*Temporary easement width is in addition to the permanent easement width. The temporary easement will be used only during construction.

Table 1-70
Land Disturbance Associated with Local Development Facilities as a Result of the MCAT Alternative

Project Feature	Areas Disturbed During Construction[a] (acres)
SU2	8.7
SU3	8.7
SU4	8.5
SU5	7.3
SU6	4.4
Total Acres[b]	**497.7**

[a]All areas disturbed during construction would be reclaimed.
[b]Includes all distribution systems developed under the MCAT Alternative.

1.9.8.7 Construction Procedures

Construction procedures for the MCAT Alternative would be the same as those identified for the Proposed Action.

1.9.8.8 Operation and Maintenance

Operation and maintenance procedures for the MCAT Alternative would be the same as described under the Proposed Action.

1.9.8.9 Distribution Pipeline Construction Schedule

The distribution pipeline construction schedule for the MCAT Alternative is shown in Figure 1-28.

1.9.9 Related Actions: No Action Alternative

Under the No Action Alternative, the SFN System would not be constructed. The 3,500 acre-feet of Bonneville Unit irrigation water that would be provided to southern Utah County under the No Action Alternative would be diverted from the Spanish Fork River. These diversions and the use of this water would not require changes to existing local irrigation distribution or on-farm systems. The 11,200 acre-feet of M&I water would be provided as described in Section 1.9.2.1.

Chapter 2

COMPARATIVE ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVES AND BONNEVILLE UNIT IMPACT ANALYSIS

Chapter 2
Comparative Analysis of the Proposed Action and Alternatives and Bonneville Unit Impact Analysis

2.1 Introduction

This section provides 1) a comparative analysis of baseline conditions and the Spanish Fork Canyon-Nephi Irrigation System (SFN System) Proposed Action and alternatives and 2) a discussion of potential environmental impacts that could occur as a result of Bonneville Unit operation that was deferred from previous environmental documents prepared for individual Bonneville Unit systems.

2.2 Comparative Impact Analysis of Baseline Conditions and the Proposed Action and Alternatives

This section presents a comparison of baseline conditions and the environmental and socioeconomic effects of the Proposed Action and each of the alternatives, based on the analyses presented in Chapter 3. A digest of the comparisons in tabular form is shown in Table 2-1.

Among the environmental and socioeconomic aspects, the most significant differences among the Proposed Action and the alternatives (the Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative" and Without Strawberry Valley Project [SVP] Water Conveyance [MCAPW-DFT] Alternative, Main Conveyance Aqueduct with Monks Hollow Dam [MCAP] Alternative, Main Conveyance Aqueduct with Monks Hollow Dam and Without SVP Water Conveyance [MCAPW] Alternative, Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam [MCATC] Alternative, Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam and Without SVP Water Conveyance [MCAT] Alternative) lie in the areas of water resources, wetland resources, aquatic resources, special-status species, and wildlife resources. Generally, the impacts would be greatest for the alternatives that would require completion of the Diamond Fork System with Monks Hollow Dam and Reservoir.

The amounts of Bonneville Unit irrigation and M&I water that would be delivered to southern Utah and eastern Juab Counties is the same for all action alternatives. The No Action Alternative, by contrast, would provide the same amount of municipal and irrigation (M&I) water, but only about 5 percent of the irrigation water of the other alternatives. Effects on wetland resources would vary. Alternatives requiring Monks Hollow Dam and Reservoir (i.e., the MCAP, MCAPW, MCATC, and MCAT Alternatives) would have the greatest effect on wetlands resulting from the inundation of portions of Diamond Fork Canyon. Wildlife resources would experience temporary and permanent disturbance from all action alternatives, with the greatest amounts projected under the alternatives with Monks Hollow Dam and Reservoir. The No Action Alternative would cause a relatively small amount of wildlife resource disturbance.

All alternatives would produce an increase in trout habitat and a corresponding increase in the production of trout, resulting in beneficial impacts to aquatic resources. The Proposed Action and the MCAPW-DFT Alternative would produce the greatest benefits, with the other alternatives each producing about 75 percent of the Proposed Action benefits, primarily as the result of stream inundation by Monks Hollow Reservoir. Recreational resources under all alternatives would experience increased in-stream sport fishing opportunities, with the Proposed Action and the MCAPW-DFT Alternative achieving the greatest benefits. Alternatives requiring Monks Hollow Dam and Reservoir would also provide increased opportunities for flatwater sport fishing.

Affected special-status species would be the Ute ladies'-tresses (*Spiranthes diluvialis*), leatherside chub (*Gila copei*), and golden eagle (*Aquila chrysaetos*). The alternatives involving construction of Monks Hollow Dam and Reservoir would eliminate less than 1 acre of Ute ladies'-tresses habitat through inundation. All alternatives would cause unquantifiable losses of individuals through streamflow changes. The leatherside chub would experience an unquantifiable loss of habitat and individuals under all alternatives. A potential for golden eagle nest disturbance during construction would exist for all alternatives.

The impacts that would likely result from the Proposed Action and the alternatives on these resources and the others contained in Table 2-1 are discussed in Chapter 3. A detailed summary of the effects under each resource category is provided at the end of each resource section in Chapter 3.

The Diamond Fork Creek flows listed on Table 2-2 occur approximately 2,500 feet downstream from the confluence of Monks Hollow and Diamond Fork Creek. The flows listed for each operational situation are 1) the average annual flow for the operational situation listed, 2) the lowest historic monthly average flow (for historic and current conditions) or lowest projected monthly average flow under the Proposed Action and the alternatives, and 3) the highest historic monthly average flow (for historic and current conditions) or highest projected monthly average flow under the Proposed Action and the alternatives. The flows for the Proposed Action and the MCAPW-DFT Alternative consist of natural flows, releases from Strawberry Tunnel, and releases from the turnout at the end of the Red Hollow Pipeline. The flows for all other alternatives consist of releases from Monks Hollow Dam or Three Forks Dam, as applicable.

Data sources for the flows shown were as follows: Historical Conditions flows were from U.S. Geological Survey (USGS) published records supplemented with computed flows in years for which no records are available; Current Conditions flows were from USGS published records; Diamond Fork 1990 Recommended Plan flows were from the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990); and Proposed Action flows and those of the alternatives were from the *Hydrology and Water Resources Technical Report* (CUWCD 1998b).

2.3 Deferred Bonneville Unit Impact Analysis

2.3.1 Introduction

Previous environmental impact statements prepared for the individual systems of the Bonneville Unit deferred analysis of certain issues associated with the operation of the Bonneville Unit as a whole. This section discusses the potential impacts of these deferred issues. The issues were deferred primarily because of uncertainties in future planning for specific components of the individual Bonneville Unit systems. These issues are addressed in this Draft Environmental Impact Statement (DEIS) for the SFN System and include the following:

- Impacts of operation of the Bonneville Unit on Strawberry Reservoir
- Impacts of diking Utah Lake
- Potential power generation associated with the Diamond Fork System
- Cumulative socioeconomic impacts associated with construction of the Diamond Fork Pipeline
- Impacts of operation of the Bonneville Unit on Utah Lake
- Cumulative impacts of historical water depletions on Colorado River fish

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions[a]

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Element	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Checklist of Major Features								
"Diamond Fork Tunnel Alternative"	NA	Yes	Yes	No	No	No	No	No
Monks Hollow Dam and Reservoir	NA	No	No	Yes	Yes	Yes	Yes	No
Three Forks Dam and Reservoir	NA	No	No	No	No	No	No	Yes
Main Conveyance Aqueduct	NA	Yes	Yes	Yes	Yes	Yes	Yes	No
Water Resources								
Changes in Annual Average Water Deliveries								
Bonneville Unit M&I water to southern Utah County (acre-feet)	0	11,200	11,200	11,200	11,200	11,200	11,200	11,200
Supplemental Bonneville Unit irrigation water to southern Utah County (acre-feet)	0	31,100	31,100	31,100	31,100	31,100	31,100	3,500
Supplemental Bonneville Unit irrigation water to eastern Juab County (acre-feet)	0	42,000	42,000	42,000	42,000	42,000	42,000	NA
Changes in Annual Average Groundwater Levels[a]								
Southern Utah Valley (feet)	Varies	2 foot increase	2 foot increase	6 foot increase	6 foot increase	6 foot increase	6 foot increase	3 foot increase
Juab Valley (feet)	Varies	25 foot increase	25 foot increase	25 foot increase	25 foot increase	25 foot increase	25 foot increase	No change from baseline
Water Quality								
Surface water (TDS, coliforms, phosphorus)	NA	No significant change	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Groundwater (TDS, phosphorus)	NA	No significant change	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Contaminants (trace metals)	NA	No significant change	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Wetland Resources								
Permanently lost[b] (acres)	NA	24	27	69	72	66	62	32.4
Wildlife Resources								
Wildlife Habitat								
Temporarily disturbed (acres)	NA	1,231	1,230	1,591	1,589	1,415	1,415	156
Permanently lost (acres)	NA	121	121	494	476	440	440	98
Converted to different habitat type (acres)	NA	173	173	175	173	122	122	0

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions[a]

Page 2 of 5

Element	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Aquatic Resources								
Stream inundated (miles)	NA	No change from baseline	No change from baseline	3.1	3.1	3.1	3.1	0.9
Riverine trout production (lb)	7,695	+15,525	+15,482	+11,432	+10,504	+11,432	+11,304	+12,684
Reservoir trout production (lb)	NA	No change from baseline	No change from baseline	+4,075	+4,075	+4,075	+4,075	
Special-Status Species								
Ute Ladies'-Tresses								
Direct impact–habitat lost through inundation (acres)	NA	No change from baseline	No change from baseline	0.6	0.6	0.6	0.6	No change from baseline
Indirect impact–flow alterations (acres)	NA	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River	Unquantified loss of individuals because of fluctuations in water releases in Diamond Fork Creek and Spanish Fork River
Leatherside Chub								
Habitat loss	NA	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation	Unquantifiable loss of habitat and individuals through flow and temperature changes and brown trout predation
Golden Eagle								
Habitat loss	NA	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance	Potential for nest abandonment from construction disturbance
Soil Resources								
Construction impacts	NA	Temporary bank erosion at creek crossings	Same as Proposed Action	Temporary bank erosion at creek crossings and at Monks Hollow Dam	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Temporary bank erosion at Three Forks Dam
Operation impacts	Unquantified bank erosion	Reduced bank erosion along Sixth Water and Diamond Fork Creeks	Same as Proposed Action	Reduced bank erosion along Diamond Fork Creek	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Increased bank erosion along Spanish Fork River
Agricultural Resources								
Utah County								
Total crop production for alfalfa, corn silage, oat hay, cherries, and apples	174,321 tons/year	Increased production of 119,468 tons/year	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Slight increase over baseline

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions[a]

Element	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Total crop production for barley and corn	732,716 bushels/year	Decreased production of 163,334 bushels per year	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Slight increase over baseline
Prime agricultural land	17,120 acres	Increase of 10,670 acres	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Slight increase over baseline
Temporary loss of current agricultural land (acres)	NA	422	569	422	569	392	64	No change from baseline
Permanent loss of current agricultural land (acres)	NA	39	58	39	58	15	1	No change from baseline
Juab County								
Total crop production for alfalfa, corn silage, oat hay, cherries, and apples	31,489 tons/year	Increased production of 73,912 tons/year	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	No change from baseline
Total crop production for barley and corn	821,488 bushels/year	Increased production of 205,671 bushels/year	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	No change from baseline
Prime agricultural land	5,000 acres	Increase of 15,338 acres	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	No change from baseline
Temporary loss of current agricultural land (acres)	NA	163	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	No change from baseline
Permanent loss of current agricultural land (acres)	NA	0	0	0	0	0	0	0
Recreation								
Stream sport fishing (angler-days/year)	7,816	+31,535	+31,454	+23,720[c]	+23,476[c]	+23,720[c]	+23,476[c]	+23,697[c]
Reservoir sport fishing (angler-days/year)	NA	NA	NA	+2,628	+2,628	+2,628	+2,628	0
Recreation trail (user-days/year)	NA	35,000	NA	35,000	NA	NA	NA	NA
Public Health and Safety/Noise								
Noise during construction (dBA)	57	Temporary local increase of up to 35 dBA	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Pipeline failure	NA	Potential for pipeline rupture to cause localized flooding	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Potential for pipeline rupture limited to Diamond Fork Canyon
Reservoir failure	NA	Embankment failure on Main Conveyance Reservoir would cause flooding in Mona	Same as Proposed Action	Embankment failure on Main Conveyance Reservoir or Monks Hollow Dam would cause flooding	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Embankment failure on Three Forks Reservoir would cause flooding
Canal drowning	Existing potential for canal drownings	Canal replacement with pipeline would reduce potential for canal drownings	No change from baseline	Same as Proposed Action	No change from baseline	Partial canal replacement with pipeline would reduce potential for canal drownings	No change from baseline	No change from baseline

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions[a]

Element	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Reservoir drowning	NA	NA	NA	Potential for drowning in Monks Hollow Reservoir	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Potential for drowning in Three Forks Reservoir
Socioeconomic Resources								
Construction and operation socioeconomic impacts	NA	No significant impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts	No significant impacts
Cultural Resources								
Disturbance to historic/archaeological sites	NA	Potential for disturbing cultural resources during construction and operation; however, mitigation would reduce to insignificant	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Similar to Proposed Action, but with less potential for disturbance
Visual Resources								
Land disturbance	NA	Visible scars to the landscape would be noticeable. Some facilities would change the characteristics of the visual setting.	Same as Proposed Action	Similar to Proposed Action, but Monks Hollow Dam and Reservoir would have greater effect on Diamond Fork drainage	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Local visual change in Diamond Fork drainage resulting from Three Forks Dam and Reservoir
Transportation Resources								
Diamond Fork Road	NA	Daily restriction to public access to Diamond Fork Road during construction	Same as Proposed Action	Diamond Fork Road would be permanently closed at Monks Hollow Reservoir	Same as MCAP Alternative	Same as MCAP Alternative	Same as MCAP Alternative	Daily restrictions to public access during construction of Three Forks Dam
Highway 6	NA	Anticipated traffic delays of 0.5 hour in Spanish Fork Canyon near Pole Canyon	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Less disruption of traffic than Proposed Action	Same as MCATC Alternative	Increase in construction traffic near Diamond Fork at Hwy 6
Traffic increase	NA	Increased traffic on Rays Valley Road and potential traffic delays at certain intersections	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Similar to Proposed Action, but lower potential for delays
Air Quality								
Construction-related fugitive dust (PM_{10})	NA	Temporary local exceedence of PM_{10} standard	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Similar to Proposed Action, but limited to Diamond Fork drainage and M&I system development

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions[a]

Element	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Land Use								
USFS Roadless Areas	Existing roads currently penetrate some areas	Increased activity during construction period adjacent to and within roadless areas; minor accessibility changes	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Mineral and Energy Resources								
Mineral resources	NA	Possible limitations to development of mineral resources	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	No change from baseline
Environmental Justice								
Disproportionate negative impacts to minority or low income population	NA	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts

NA= Not applicable
[a]Includes impacts of construction and operation of local development systems.
[b]Conversion from a vegetated wetland community type (e.g., wet meadow) to a non-vegetated wetland community type (e.g., creek bed/riverine). Also includes impacts from placement of fill. All wetland impacts would be mitigated.
[c]Loss of angler use resulting from inundation by Monks Hollow Reservoir and Three Forks Reservoir is included in calculation of angler use increases for alternatives over baseline conditions.

Table 2-1
Comparison of Impacts of the Proposed Action and Project Alternatives to Baseline Conditions

Table 2-2
Comparison of Water Operation Under Historical Conditions and SFN System Alternatives

Operational Situation	SFN System	Diamond Fork System	Diamond Fork Creek Flows
Historical Conditions (valid prior to 1996)	No SFN System. Historical conditions on the Spanish Fork River, including SVP deliveries averaging 61,500 acre-feet per year.	No Diamond Fork System. Transbasin diversion made through Strawberry Tunnel. Historical flows in Diamond Fork Creek, including SVP deliveries.	Average Annual Flow - 104 cfs Lowest Monthly Average - 3 cfs Highest Monthly Average - 421 cfs
Current Conditions (Valid from 1996)	No SFN System. The Spanish Fork River carries natural flow and SVP deliveries averaging 61,500 acre-feet per year.	Diamond Fork System not completed. Transbasin diversion made through Syar Tunnel/Sixth Water Aqueduct. Flows in Diamond Fork Creek consist of natural flow plus Strawberry Valley Project deliveries. Diamond Fork Pipeline is not used.[a]	Average Annual Flow - 161 cfs Lowest Monthly Average - 3 cfs Highest Monthly Average - 500 cfs
Diamond Fork 1990 Recommended Plan	I&D System would be constructed. Bonneville Unit releases from Strawberry Reservoir would average 101,900 acre-feet per year.	Diamond Fork System would be constructed with Monks Hollow Dam and Reservoir and would include three hydro power plants.	Average Annual Flow - 64 cfs Lowest Monthly Average - 5 cfs Highest Monthly Average - 386 cfs
Proposed Action	The Main Conveyance Aqueduct would be built to convey Bonneville Unit and SVP water. Bonneville Unit releases from Strawberry Reservoir would average 101,900 acre-feet per year.	The "Diamond Fork Tunnel Alternative" would be constructed to convey water to the Diamond Fork Pipeline and to the Main Conveyance Aqueduct. Diamond Fork Pipeline capacity would be 560 cfs.	Average Annual Flow - 82 cfs Lowest Monthly Average - 60 cfs Highest Monthly Average - 395 cfs
MCAPW-DFT Alternative	The Main Conveyance Aqueduct would be built to convey only Bonneville Unit water. Bonneville Unit releases from Strawberry Reservoir would average 101,900 acre-feet per year.	Same facilities as Proposed Action.	Same as Proposed Action.
MCAP Alternative	Same facilities as Proposed Action.	Monks Hollow Dam would be constructed and would divert water into the Diamond Fork Pipeline and on to the Main Conveyance Aqueduct. Diamond Fork Pipeline capacity: 510 cfs.	Average Annual Flow - 82 cfs Lowest Monthly Average - 60 cfs Highest Monthly Average - 357 cfs
MCAPW Alternative	Same facilities as MCAPW-DFT Alternative.	Same facilities as MCAP Alternative.	Same as MCAP Alternative.
MCATC Alternative	The Main Conveyance Aqueduct would be built (with a tunnel through Loafer Mountain) to convey Bonneville and SVP water. Bonneville Unit releases from Strawberry Reservoir would average 101,900 acre-feet per year	Same facilities as MCAP Alternative.	Same as MCAP Alternative.
MCAT Alternative	Same as MCATC Alternative, but Main Conveyance Aqueduct would not deliver SVP water.	Same facilities as MCAP Alternative.	Same as MCAP Alternative.
No Action Alternative (includes CUPCA minimum flows)	No SFN System. Bonneville Unit Water would be available only to diverters from the Spanish Fork River and for delivery to Utah Lake. Bonneville Unit releases from Strawberry Reservoir would average 96,800 acre-feet per year.	Three Forks Dam would be constructed and would divert water into an extended Diamond Fork Pipeline, which would discharge into Diamond Fork Creek at the Spanish Fork River confluence. Diamond Fork Pipeline capacity: 510 cfs.	Average Annual Flow - 78 cfs Lowest Monthly Average - 60 cfs Highest Monthly Average- 395 cfs

[a]There is currently no structure to divert water into the Diamond Fork Pipeline.

2.3.1.1 *Deferred Bonneville Unit Issues Eliminated from Further Analysis*

Three of the six issues listed in Section 2.3.1 have been eliminated from further analysis for the following reasons:

- The operation of Strawberry Reservoir was addressed in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990), and development of the SFN System would not change the conditions analyzed in that document. Further, operation of the Bonneville Unit has been designed to avoid changes in the operation of Strawberry Reservoir as elements of the Bonneville Unit are constructed and implemented. For these reasons, impacts to Strawberry Reservoir are not analyzed in this DEIS.

- Proposals to dike off certain portions of Utah Lake as part of the Bonneville Unit are no longer being considered and, therefore, are not analyzed in this document.

- Plans for federally-funded power generation have been eliminated from the Diamond Fork System. Additionally, no other entities have developed proposals for power generation associated with the Diamond Fork System; therefore, this issue cannot be evaluated.

2.3.1.2 *Deferred Bonneville Unit Issues Addressed in This Analysis*

The remainder of this chapter addresses potential Bonneville Unit operational impacts on Utah Lake and cumulative impacts of the Bonneville Unit and historical water depletions on Colorado River fish associated with the Duchesne River. The discussion of the Bonneville Unit impacts on Utah Lake included potential impacts on the Jordan River. It has been determined that completion of the Bonneville Unit as proposed would not result in significant impacts to the Great Salt Lake. The information provided in the following sections has been summarized from the *Aquatic Resources Technical Report* (CUWCD 1998a), *Environmental Contaminants Technical Report* (CUWCD 1997a), *Special-Status Species Technical Report* (CUWCD 1998c), *Utah Lake Hydrology Technical Report* (CUWCD 1998f), and *Wetland Resources Technical Report* (CUWCD 1998d).

2.3.2 Operation of Bonneville Unit and Utah Lake

Under the operation of the Bonneville Unit, Utah Lake will serve as a common operational interface between the Strawberry Collection, Diamond Fork, SFN, and Municipal and Industrial (M&I) Systems. Utah Lake is also the common operational interface for water transfers within the Bonneville Unit. Section 1.2.4 of Chapter 1 discusses and documents the environmental compliance of the various systems of the Bonneville Unit as well as some of the major changes that have occurred within the Bonneville Unit. Releases are made from Strawberry Reservoir to Utah Lake to meet instream flow requirements on Diamond Fork Creek during the winter months and on an as-needed basis to replace a portion of the M&I water withheld from Utah Lake by Jordanelle Dam and Provo River water diversions for Bonneville Unit uses. The Diamond Fork System will serve as the conveyance system for releases to Utah Lake and would also provide transbasin deliveries to the SFN System.

Bonneville Basin water developed for the SFN System and Bonneville Unit return flows to Utah Lake would affect the magnitude and timing of inflow to the lake. The historical flow and timing of Provo River inflow to Utah Lake will be modified by the operation of the M&I System. Water would be replaced in Utah Lake through releases from Strawberry Reservoir, project return flows, acquisition of Utah Lake water rights, and modified operations of the lake. Impacts to Utah Lake that would result from the operation of the Bonneville Unit are addressed in greater detail in the *Utah Lake Hydrology Technical Report* (CUWCD 1998f).

Bonneville Unit operations were developed to provide a water supply for the water users in the Bonneville Basin with an objective of minimizing Bonneville Unit operational effects on Utah Lake. A description of the

development of criteria, data, and analyses used for baseline and Bonneville Unit conditions is included in the *Utah Lake Hydrology Technical Report* (CUWCD 1998f).

The total inflow to Utah Lake varies from about 340,000 acre-feet to 1,150,000 acre-feet, with an average of about 568,000 acre-feet. At the compromise elevation of 4,489.045 feet, the lake has a capacity of 870,000 acre-feet with a surface area of 95,000 acres. The compromise elevation of Utah Lake is based on a 1989 agreement with landowners adjacent to the lake who are concerned with flooding and water users who are dependent on the lake as a storage reservoir. The agreement established that during periods when the lake is expected to exceed compromise level, the gates at the dam will remain open until the lake recedes to compromise elevation.

The Central Utah Water Conservancy District (CUWCD) has acquired 82,000 acre-feet of water rights in Utah Lake, including the 25,000 acre-feet of primary rights from Salt Lake City and approximately 57,000 acre-feet of secondary rights from Kennecott Copper Company. Historically, these water rights have yielded an average annual water supply of 50,240 acre-feet. In addition, the CUWCD also owns approximately 5,000 acre-feet in the form of shares in various irrigation companies that use Utah Lake water. Water rights defined by the Morse Decree to have storage rights in Utah Lake are primary rights, and storage rights established by applications to appropriate water confirmed by the Booth Decree are secondary rights.

2.3.3 Bonneville Unit Impacts on Utah Lake

The areas of influence associated with the impacts of the Bonneville Unit on Utah Lake include Utah Lake, adjacent environmental resources that could be affected by lake elevation changes, irrigated lands that use Utah Lake water, and the Jordan River environment from Utah Lake downstream to the Great Salt Lake. As stated previously, the Bonneville Unit would not have a significant impact on the Great Salt Lake, and therefore, the Great Salt Lake is not included in the following discussion.

2.3.3.1 Water Resources

Under the Bonneville Unit, Utah Lake will serve as a common operational interface between the Strawberry Collection, Diamond Fork, SFN, and M&I Systems. The U.S. Bureau of Reclamation's *Bonneville Unit Final EIS* (USBR 1973), *Draft Supplement to the M&I System's Final Environmental Impact Statement* (USBR 1987a), and *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) each deferred discussion of Utah Lake and Jordan River impacts until all systems, including the irrigation system (SFN System), could be further evaluated and the total project effects assessed. This analysis is intended to serve that purpose.

To determine the total impact of the Bonneville Unit on Utah Lake, the operation of Utah Lake under full Bonneville Unit development was compared with future conditions without the Bonneville Unit, but with projected changes associated with other projects, existing or planned. The future-without-Bonneville Unit conditions serve as the baseline for the environmental impact analysis. Baseline conditions were developed by modifying historical inflow and Utah Lake operations to reflect the following:

- The future operations and level of depletion of the Provo River Project and water developments other than the Bonneville Unit
- The compromise elevation of 4,489.045 feet and the flood management plan for Utah Lake and the Jordan River
- The Utah State Engineer's plan entitled *Interim Water Distribution Plan for the Utah Lake Drainage Basin* (Distribution Plan), including maximum drawdown to 8.7 feet below compromise elevation, redefined diversion requirements for Utah Lake releases to the Jordan River, and specified water conservation levels for primary and secondary water rights (Utah Division of Water Rights 1992)

Under baseline conditions, it is assumed that Utah Lake water rights will continue to be used in accordance with historical patterns. However, over time, the use of the water will likely convert from agricultural to municipal and industrial. It is assumed that the Utah Lake water rights acquired by the CUWCD would be used by others in Salt Lake County if the Bonneville Unit were not constructed.

Because of increased population, baseline conditions also include the assumption that M&I return flows would be greater than those that have occurred historically. It is assumed that 45,500 acre-feet of additional M&I return flow would occur in Salt Lake County. About 13,000 acre-feet of this return flow would flow directly to the Great Salt Lake and about 32,500 acre-feet would flow into the Jordan River upstream from 2100 South Street.

2.3.3.1.1 Impact on Utah Lake. The effects of the Bonneville Unit on Utah Lake would be essentially the same for all the SFN System alternatives, including the Proposed Action. As a result of the Bonneville Unit, water would be released from Strawberry Reservoir to Utah Lake to meet instream flow requirements on Sixth Water and Diamond Fork Creeks and on an as-needed basis to replace a portion of the M&I water withheld from Utah Lake by Jordanelle Dam and Provo River water diversions for Bonneville Unit uses. The Diamond Fork System would serve as the conveyance system for releases to Utah Lake and would also provide transbasin deliveries to the SFN System. SFN System return flows would also provide additional inflow to the lake. The historical flow and timing of Provo River inflow to Utah Lake have been modified by operation of the M&I System. Water would be replaced in Utah Lake through releases from Strawberry Reservoir, SFN System return flows, and Utah Lake water rights owned by the CUWCD.

A comparison of Utah Lake water budgets for baseline and Bonneville Unit conditions is shown in Table 2-3. As shown in the table, the average inflow under Bonneville Unit conditions is about 529,000 acre-feet annually, or an average reduction of about 39,000 acre-feet from baseline conditions. The average reduction in Provo River inflow to Utah Lake is about 95,500 acre-feet; the M&I System return flows add about 13,000 acre-feet, the Strawberry Reservoir releases add about 33,500 acre-feet, the SFN System return flows add about 21,000 acre-feet annually, and the SFN System M&I exchange decreases groundwater and other inflows to the lake by about 11,200 acre-feet annually.

The primary effect of the Bonneville Unit on surface water elevations would be to maintain Utah Lake at an average long-term elevation nearly the same as that which would occur as a result of baseline conditions. As a result of the Bonneville Unit conditions, the range of annual fluctuations of surface elevation would be reduced by 0.3 foot (from 2.8 feet to 2.5 feet). Drought periods would still occur but would be less severe.

The monthly water elevations in Utah Lake at low, average, and high lake elevations are shown in Table 2-4. The difference in lake elevations would be similar to baseline conditions for all months.

Operation of the Bonneville Unit would cause some minor changes in the content and water surface elevation of Utah Lake. The annual maximum and minimum storage content of the lake for each year over the 1930 to 1973 period for baseline and Bonneville Unit conditions are compared on Figure 2-1.

2.3.3.1.2 Impact on Jordan River. The outflow from Utah Lake to the Jordan River under Bonneville Unit conditions is based on a reduction in future water rights and water delivery, reflecting the CUWCD's acquisition of Utah Lake water rights. Under Bonneville Unit conditions, the water associated with the acquired rights will remain in the lake to balance the net difference of inflow, outflow, and evaporation losses.

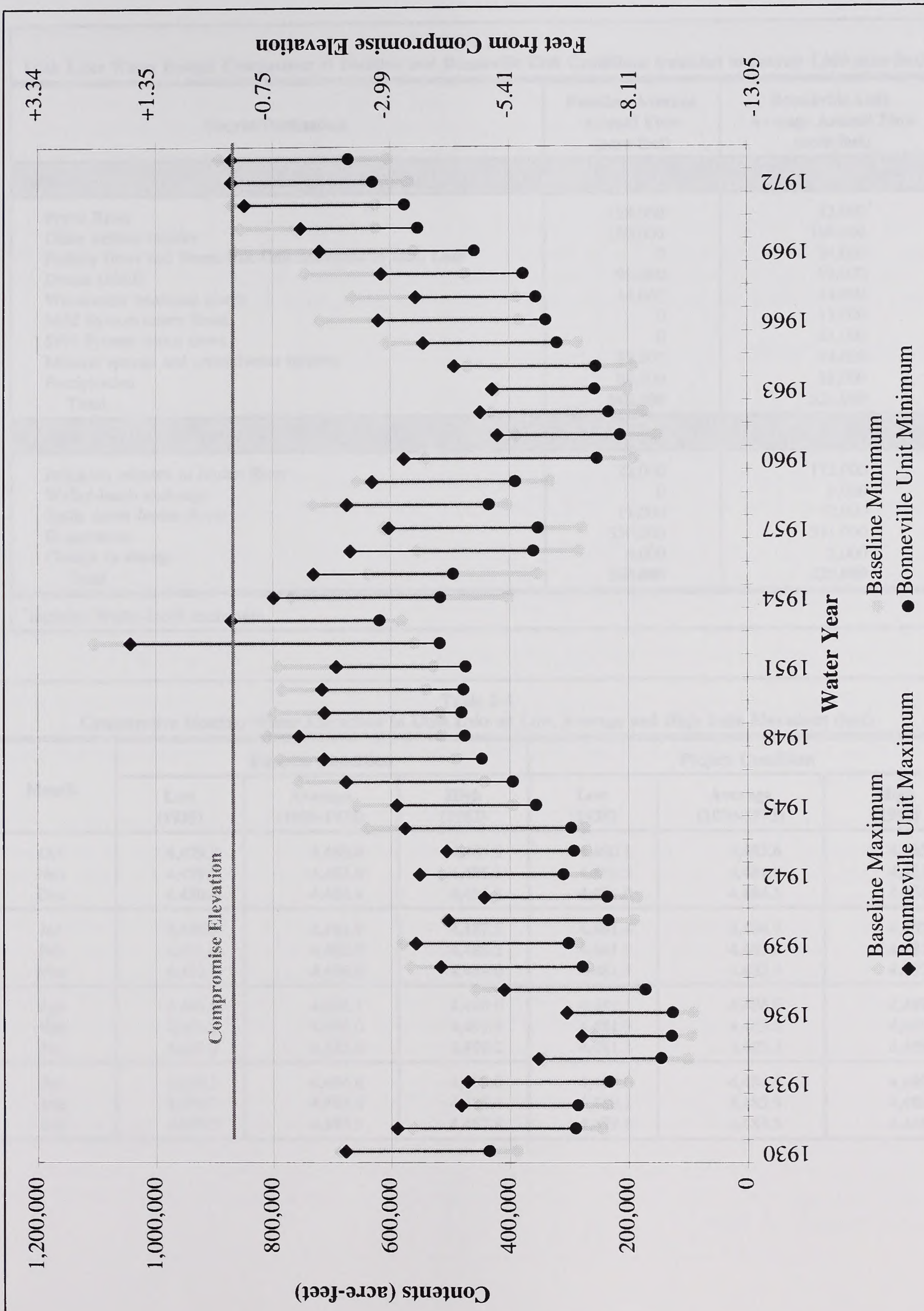


Figure 2-1
Utah Lake Annual Maximum and Minimum
Baseline and Bonneville Unit Storage Contents

Table 2-3
Utah Lake Water Budget Comparison of Baseline and Bonneville Unit Conditions (rounded to nearest 1,000 acre-feet)

Source/Destination	Baseline Average Annual Flow (acre-feet)	Bonneville Unit Average Annual Flow (acre-feet)
Inflows		
Provo River	128,000	32,000*
Other surface inflows	160,000	160,000
Fishery flows and Bonneville Unit deliveries to Utah Lake	0	34,000
Drains (M&I)	93,000	93,000
Wastewater treatment plants	14,000	14,000
M&I System return flows	0	13,000
SFN System return flows	0	21,000
Mineral springs and groundwater inflows	85,000	74,000
Precipitation	88,000	88,000
Total	**568,000**	**529,000**
Outflows and Change in Storage		
Irrigation releases to Jordan River	22,000	172,000
Welby-Jacob exchange	0	9,000
Spills down Jordan River	11,000	12,000
Evaporation	330,000	331,000
Change in storage	4,000	5,000
Total	**568,000**	**529,000**

*Includes Welby-Jacob exchanges

Table 2-4
Comparative Monthly Water Elevations in Utah Lake at Low, Average and High Lake Elevations (feet)

Month	Baseline Condition			Project Condition		
	Low (1935)	Average (1930-1973)	High (1952)	Low (1935)	Average (1930-1973)	High (1952)
Oct	4,479.3	4,483.4	4,485.6	4,480.1	4,483.6	4,485.1
Nov	4,479.7	4,483.8	4,486.1	4,480.5	4,484.0	4,485.5
Dec	4,480.4	4,484.4	4,486.8	4,481.0	4,484.5	4,486.2
Jan	4,480.9	4,484.9	4,487.5	4,481.4	4,484.9	4,487.0
Feb	4,481.4	4,485.5	4,488.2	4,481.9	4,485.5	4,487.4
Mar	4,481.6	4,486.0	4,489.0	4,481.9	4,485.9	4,487.9
Apr	4,481.8	4,486.1	4,490.0	4,482.1	4,486.0	4,489.0
May	4,481.6	4,486.0	4,491.4	4,481.9	4,485.8	4,490.8
Jun	4,481.2	4,485.6	4,490.2	4,481.3	4,485.2	4,489.8
Jul	4,480.3	4,484.6	4,489.0	4,480.6	4,484.5	4,489.0
Aug	4,479.7	4,483.8	4,488.4	4,480.1	4,483.9	4,488.5
Sep	4,479.3	4,483.3	4,487.8	4,479.8	4,483.5	4,488.1

A comparison of average monthly baseline and Bonneville Unit flows of the Jordan River at the Jordan Narrows for dry, average, and wet conditions is shown in Table 2-5. A similar analysis for the Jordan River at 2100 South Street is provided in Table 2-6. As shown in Table 2-5, the overall average flow is reduced by about 21 percent in the Jordan River at the Jordan Narrows. However, in most years, flows at 2100 South Street would be essentially unchanged because all of the water rights acquired by the CUWCD were historically diverted from the river at the Narrows. In wet years, peak flood flows at 2100 South Street would be reduced under Bonneville Unit conditions.

Return flow patterns to the Jordan River are assumed to be the same under baseline and Bonneville Unit conditions. If Bonneville Unit water were not available, M&I water suppliers would need to develop other water sources to meet existing and future M&I water demands. Had the CUWCD not purchased Utah Lake water rights, those water rights would likely have been purchased by others and converted to M&I use.

2.3.3.2 Water Quality

Studies of the water quality of Utah Lake indicate that the lake has historically been turbid and biologically highly productive. Hypereutrophic loadings of total phosphorus and inorganic nitrogen occur in the lake, but have little effect on productivity because high turbidity limits light penetration into the water. The effects of the operation of the Bonneville Unit on Utah Lake water quality would not result in a measurable change in nutrients, pesticides, heavy metals, or other trace elements as a result of increased return flow or direct delivery of water.

Average total dissolved solids (TDS) in Utah Lake would increase with operation of the Bonneville Unit. The average TDS of the lake would increase from 1,142 parts per million (ppm) to 1,237 ppm, representing an 8 percent increase (see Table 2-7). However, the peak TDS concentrations would be reduced, for both monthly and annual averages, for low lake elevations under the Bonneville Unit. A plot of the annual high and low values of TDS as a water quality indicator for baseline and Bonneville Unit conditions is shown on Figure 2-2.

2.3.3.2.1 Use of Utah Lake Water. The effects of increased salinity on crops and other vegetation irrigated by water from Utah Lake are difficult to quantify because of seasonal variability of the lake's salinity levels, soil conditions of the cultivated areas, and methods of irrigation. Additionally, the salinity tolerances between plant species vary widely.

Generally, salinity of irrigation water can be divided into four classes with respect to electrical conductivity (EC) (these are defined in Table 2-8). Low-salinity, or C1, waters can be used to irrigate most crops on most soils with little likelihood that soil salinity will develop. Some leaching is required, but this occurs under normal irrigation practices except in soils of extremely low permeability. C2 water can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerances can be grown in most cases without special practices for salinity control. C3 water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required, and plants with good salt tolerance should be selected. C4 water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt-tolerant crops should be selected.

Because Utah Lake water has historically been used primarily to irrigate crops, the effects of the Bonneville Unit on the use of Utah Lake water for irrigation are determined by comparing the EC of Utah Lake water under baseline and Bonneville Unit conditions. The Bonneville Unit would cause an average annual increase in Utah Lake TDS of about 8 percent. This increase in TDS would cause a corresponding increase in EC. The percentage of time that Utah Lake water falls within the various classes described above for baseline and Bonneville Unit conditions is compared in Table 2-8.

Table 2-5
Comparative Average Monthly Flows in the Jordan River at the Jordan Narrows

Month	Baseline			With Bonneville Unit								
	Average Monthly Flow (cfs)			Change In Average Monthly Flow (cfs)			Average Monthly Flow (cfs)			Percent Change in Average Monthly Flow		
	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)
October	83	197	246	-24	-43	-58	60	153	188	-28	-22	-24
November	16	57	101	-1	-13	-24	14	44	77	-9	-23	-24
December	18	44	98	-4	-10	-23	14	34	75	-24	-24	-24
January	0	55	98	0	2	-23	0	57	75	0	4	-24
February	0	70	104	0	-7	227	0	63	331	0	-10	217
March	0	115	147	0	23	425	0	138	572	0	20	290
April	0	254	1,337	0	-76	-599	0	179	737	0	-30	-45
May	546	652	1,836	-100	-148	-468	446	504	1,367	-18	-23	-26
June	509	749	2,592	-102	-164	-313	407	586	2,279	-20	-22	-12
July	368	858	1,339	-58	-205	-627	310	653	713	-16	-24	-47
August	166	759	844	39	-166	-200	204	592	644	24	-22	-24
September	0	598	660	83	-132	-156	83	466	504	NA	-22	-24
Average	**142**	**367**	**783**	**-14**	**-78**	**-153**	**128**	**289**	**630**	**-10**	**-21**	**-20**

Table 2-6
Comparative Average Monthly Flows in the Jordan River at 2100 South Street

Month	Baseline			With Bonneville Unit								
	Average Monthly Flow (cfs)			Change in Average Monthly Flow (cfs)			Average Monthly Flow (cfs)			Percent Change in Average Monthly Flow		
	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)	Dry (1961)	Average (1945-1973)	Wet (1952)
October	269	333	403	0	0	0	269	333	403	0	0	0
November	269	287	266	0	0	0	269	287	266	0	0	0
December	256	291	369	0	0	0	256	291	369	0	0	0
January	236	299	395	0	11	0	236	310	395	0	4	0
February	240	309	387	0	6	252	240	316	638	0	2	65
March	252	345	515	0	42	460	252	387	974	0	12	89
April	247	413	1,684	0	-33	-539	247	380	1,145	0	-8	-32
May	253	535	1,928	0	-12	-306	253	523	1,623	0	-2	-16
June	178	632	2,636	0	-4	-120	178	628	2,516	0	-1	5
July	252	441	1,008	0	-14	-406	252	427	603	0	-3	-40
August	236	397	491	0	0	0	236	397	491	0	0	0
September	189	409	360	0	0	0	189	409	360	0	0	0
Average	**240**	**391**	**870**	**0**	**0**	**-55**	**240**	**391**	**815**	**0**	**0**	**-6**

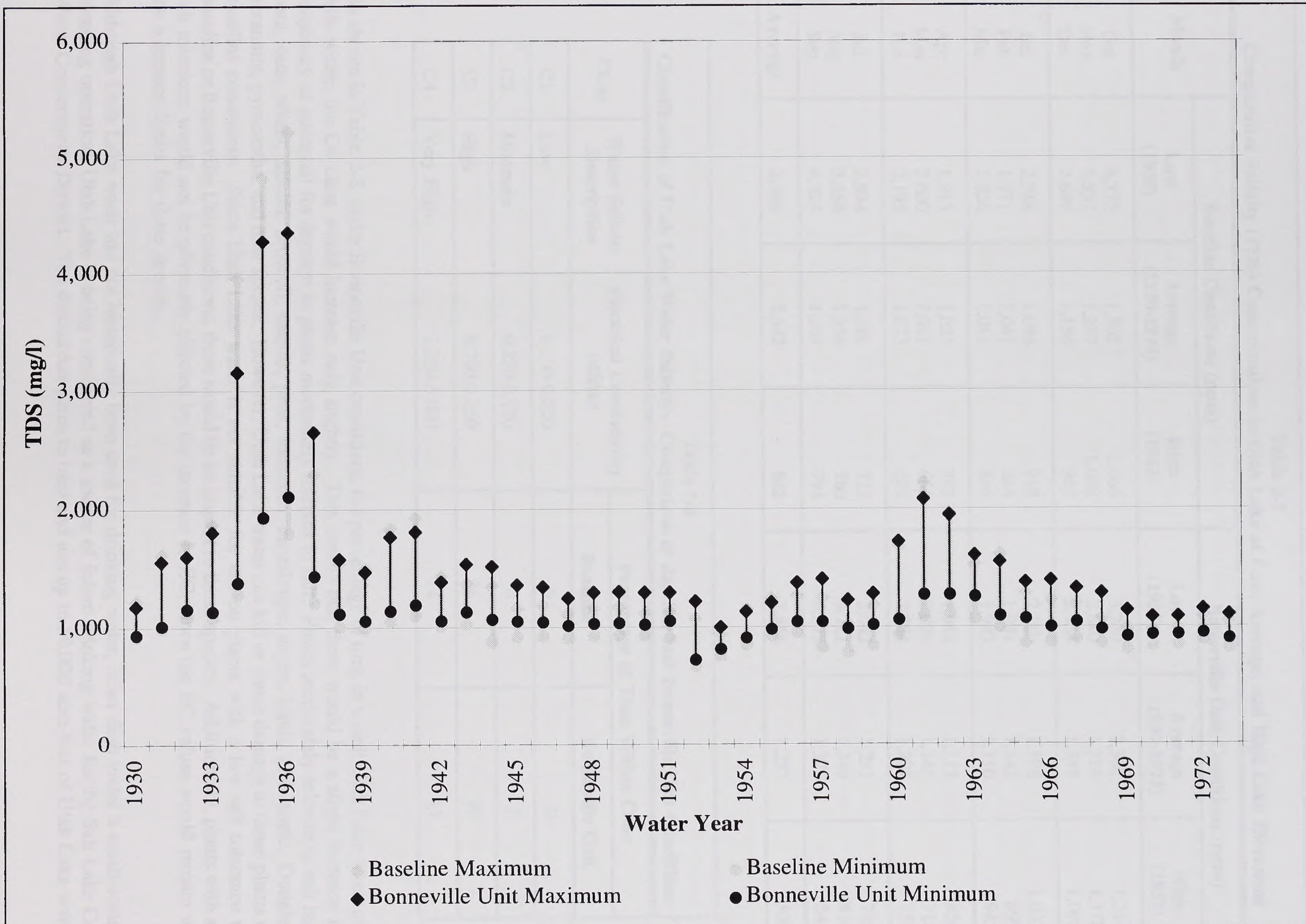


Figure 2-2
Utah Lake Annual Maximum and Minimum
Baseline and Bonneville Unit TDS Levels

Table 2-7
Comparative Salinity (TDS) Concentrations in Utah Lake at Low, Average, and High Lake Elevations

Month	Baseline Conditions (ppm)			Bonneville Unit Conditions (ppm)		
	Low (1935)	Average (1930-1973)	High (1952)	Low (1935)	Average (1930-1973)	High (1952)
Oct	4,272	1,302	1,066	3,230	1,368	1,214
Nov	3,537	1,237	1,028	2,840	1,314	1,178
Dec	2,649	1,156	962	2,434	1,249	1,095
Jan	2,248	1,094	918	2,180	1,196	1,032
Feb	1,971	1,041	884	1,931	1,142	999
Mar	1,926	1,011	846	1,983	1,110	942
Apr	1,913	1,021	763	1,943	1,117	850
May	2,000	1,041	665	2,026	1,145	718
Jun	2,195	1,073	682	2,384	1,201	730
Jul	2,924	1,168	733	3,042	1,281	785
Aug	3,858	1,256	760	3,721	1,349	816
Sep	4,824	1,301	793	4,278	1,377	843
Average	**2,860**	**1,142**	**842**	**2,666**	**1,237**	**933**

Table 2-8
Classification of Utah Lake Water Salinity: Comparison of Baseline and Bonneville Unit Conditions

Class	Water Salinity Description	Electrical Conductivity (dS/m)	Percentage of Time Within Class	
			Baseline	Bonneville Unit
C1	Low	0.100-0.250	0	0
C2	Moderate	0.250-0.750	0	0
C3	High	0.750-2.250	86	83
C4	Very High	2.250-5.000	14	17

As shown in Table 2-8, under Bonneville Unit conditions, the percentage of time in which Utah Lake water quality falls within the C4 class would increase only slightly. This means that there would be a slight increase in the frequency of potential for damage to plants moderately tolerant to salt. Plants moderately tolerant to salt include corn, oats, wheat, alfalfa, broccoli, carrots, peas, tomatoes, cantaloupe, aspen, birch, crab apple, Douglas fir, geranium, pyracantha, and blue spruce. However, Utah Lake water can kill or cause damage to those plants under baseline conditions. Since Utah Lake water is not suitable for use on plants with a low salt tolerance under baseline or Bonneville Unit conditions, there would be no impact to those species. Additionally, plants with a high salt tolerance would not be adversely affected by the increase in EC, since the EC values would remain within the tolerance limits for those species.

Although Utah Lake water has not historically been used for drinking water, other than under a small-scale trial blending operation, Utah Lake is being considered as a source of future drinking water for the Salt Lake County Water Conservancy District. The district has plans to treat and use up to 50,000 acre-feet of Utah Lake water for

drinking water. Under this plan, the water would be treated using a membrane treatment process that includes microfiltration and reverse osmosis.

The estimated cost for treating Utah Lake water for drinking water is $450 to $500 per acre-foot at present TDS levels. Increases in raw water TDS will increase the cost of the finished water. As the TDS of the raw water increases, the recovery rate for the finished water decreases and the amount of brine produced increases. The average increase in Utah Lake TDS of 8 percent attributable to the Bonneville Unit is estimated to increase the cost of treating Utah Lake water for drinking purposes by about 2 percent, or $9 to $10 per acre-foot. With 50,000 acre-feet of Utah Lake water treated, the increased annual cost would be $450,000 to $500,000.

2.3.3.2.2 Jordan River. The above-discussed return flows would result in a negligible change in TDS compared to baseline levels. A comparison of the historical TDS levels to those that would occur as a result of increased return flows to the lower Jordan River under full operation of the Bonneville Unit is shown in Table 2-9.

2.3.3.3 Wetland Resources

2.3.3.3.1 Utah Lake. Seven major wetland community types have been identified around Utah Lake: wet meadow, saline playa, marsh, riverine, aquatic/open water, riparian shrub, and riparian forest. Within the riparian communities, dense stands of tamarisk (*Tamarisk ramosissima*) and Russian olive (*Elaeagnus angustifolius*) occur. In many instances, these two exotics, tamarisk in particular, are displacing the native riparian community vegetation.

The wet meadow is a major cover type in Utah County wetlands. Most of the wet meadow communities occupy the lower areas along shorelines around Utah Lake. Saline playas form in old lakebeds or other shallow, usually closed depressions in areas with restricted (none to very limited) infiltration and are characterized by highly saline soil conditions. The most notable playas in the region are White Lake and much of the adjacent lowlands south of Goshen Bay. Playas are also found scattered throughout the wet meadow community in the Benjamin Slough area.

Marsh communities are found on the margins of Utah Lake and in smaller patches along the fringes and slower-moving portions of local creeks and rivers inside the area of influence, such as the Spanish Fork River and the Jordan River. For the context of this report, the marsh community represents several plant communities, all of which were wetter than the areas designated as wet meadows. They were often inundated but support a wide variation of water fluctuation.

Riparian forest exists on the south shores of Utah Lake between Benjamin Slough and the mouth of the Spanish Fork River where tamarisk tree/shrubs dominate. Other riparian forest areas along the Utah Lake shoreline were subjected to prolonged flooding in 1983. These areas are dominated by extensive stands of tamarisk and pepperplant (*Lepidium montanum*) that are displacing valuable native vegetation. Although some native willow (*Salix* spp.) and cottonwood (*Populus* spp.) remain, tamarisk has taken over extensive tracts of formerly mixed deciduous woodland habitat along the moister immediate shoreline. Pepperweed dominates openings within the tamarisk canopy and is additionally occupying the lower moisture regime saltgrass (*Distchilis spicata*) community inland from the shoreline.

The riparian shrub community lies within several reaches of streams within the impact area of influence and are often associated with natural springs, rivers, canals, ditches, and areas receiving irrigation return flows. These riparian edges are found near the confluence with Utah Lake, Beer Creek (Benjamin Slough), the lower Spanish Fork River (below the Strawberry Diversion Dam and above Utah Lake), the Jordan River, and shoreline areas of Utah Lake.

Table 2-9
Average Monthly Comparative Salinity (TDS) Levels in the Jordan River at the Jordan Narrows and 2100 South Street*

Month	Baseline		With Bonneville Unit					
	TDS (ppm)		Change in TDS (ppm)		TDS (ppm)		Percent Change in TDS	
	Jordan Narrows	2100 South	Jordan Narrows	2100 South	Jordan Narrows	2100 South	Jordan Narrows	2100 South
October	916	932	75	12	990	994	8	1
November	895	1,138	70	19	965	1,158	8	2
December	874	923	65	26	938	949	7	3
January	848	989	58	24	906	1,013	7	2
February	819	950	51	26	870	977	6	3
March	796	941	46	27	542	967	6	3
April	780	846	42	23	822	870	5	3
May	737	701	31	8	769	709	4	1
June	758	492	36	6	794	498	5	1
July	808	791	49	5	857	797	6	1
August	854	1,019	60	4	914	1,023	7	0
September	859	1,014	61	6	920	1,020	7	1
Average	829	895	54	16	882	910	6	2

*Average of 1980-1982 data.

The riverine and aquatic/open water community types are the open water components of the aquatic system. The riverine designation is used for stream and river systems to represent the open, typically unvegetated channel. The aquatic/open water designation is used for Utah Lake (lacustrine), smaller ponds, and reservoirs of the palustrine system. Little information is available on the submergent community of Utah Lake. Several small isolated pondweed bed areas occur in Utah Lake; however, they appear to be typically devoid of significant submergent growth. Non-wetland vegetation communities present within the area of influence include annual weed, shrubland, and agriculture.

2.3.3.3.1.1 Impacts. The primary effect of the Bonneville Unit operation, as it relates to wetlands, would be to maintain Utah Lake at an average long-term elevation similar to that which occurs as a result of baseline conditions, only slightly increasing open water habitat but reducing the range of annual surface water fluctuations by 0.3 foot. The distance from open water to the shoreline would be slightly reduced, particularly in drought years, since the lake would be held slightly higher (less than 1 foot) than baseline low water conditions. The greatest lateral changes in water levels would occur in Provo Bay and Goshen Bay. Under Bonneville Unit conditions, the amount of open water within Provo Bay during the average annual low water conditions would increase, but only slightly. High water conditions would be nearly the same as those that occur as a result of baseline conditions. The extreme high water, such as occurred during the 1952 and 1983 floods, would still occur.

Reductions of both annual and long-term fluctuations would not result in any loss of existing wetlands since the wetlands present within the impact area of influence would continue to experience similar hydrologic regimes as those that occur as a result of baseline conditions. Under Bonneville Unit conditions, the amount of aquatic bed/ open water community would increase, but only slightly.

With full operation of the Bonneville Unit, an 8 percent increase in average annual salinity would occur over baseline conditions, increasing from 1,142 to 1,237 ppm. (On a monthly basis, the greatest monthly percentage increase in salinity would occur in June, with salinity levels increasing from 1,073 to 1,201 ppm, or about 12 percent). The salinity tolerance range for the saline meadow and riparian shrub dominated by tamarisk communities is wide (100 to 15,000 ppm), but is narrower for the wet meadow, marsh, and riparian communities (50 to 5,000 ppm). The predicted increase in salinity with full operation of the Bonneville Unit is well within the tolerance range of all the wetland communities present, and no adverse impact to these communities would result.

2.3.3.3.2 Jordan River. The Jordan River from the outlet of Utah Lake to the Jordan Narrows is considered fairly natural, and the wetland communities present include riverine, riparian, and aquatic/open water. Areas adjacent to the river are primarily farmed or grazed.

From the Jordan Narrows downstream 1,200 feet, the river has been channelized and riprapped. There is a small amount of riparian habitat made up of about 10 percent cottonwoods. Adjacent floodplains consist of willow and cottonwood. Below the Jordan Narrows, the channel forks into a series of braided flood channels and the riparian community there is composed of oak brush, tamarisk, and willow. Further downstream, the river has been channelized and riprapped along certain sections, but along other sections, the channel again forks and forms a flood control complex supporting dense growth of oak/boxelder (*Acer negundo*), overstory, and stands of streamside willow (*Salix* spp.), cattails (*Typha latifolia*), sedge (*Calix* spp.), and bullrush.

Downstream toward the South Jordan Bridge (10600 South) and the Sandy Bridge (9000 South), the river has been manipulated by artificial flood control techniques and dredging. Spoil piles from the dredging are located along the banks, some of which have revegetated. Grazing occurs along segments and, in some cases, the grazing has removed the streamside riparian habitat. Where riparian vegetation is present, the overstory is not well-developed; understory species include willow and tamarisk.

Further downstream, between 5300 South Bridge to 4800 South Bridge, the river is stable in terms of erosion and bank cutting, and therefore, supports dense growths of riparian vegetation. The adjacent floodway has been left

open to function well for seasonal flood storage. The floodway has numerous oxbows that support dense stands of riparian vegetation and adjacent wetlands.

From 4800 South Bridge to the Great Salt Lake, this pattern of alternating channelized riprapped segments and more natural segments continues. Where riparian vegetation is present (e.g., oxbows and the bottom and top of channel banks), it includes primarily understory vegetation (e.g., willow, tamarisk) but also has some mature overstory species (e.g., boxelder and cottonwood). Saline meadow wetlands are also found in adjacent areas along the river.

2.3.3.3.2.1 Impacts. From Utah Lake to the Jordan Narrow, flows within the Jordan River would decrease by an average of 22 percent, but would increase in March. This decrease is not expected to adversely impact the riparian shrub and aquatic open water habitats because flows to support these communities would still be available. Below the Jordan Narrows, flows at 2100 South Street would be essentially unchanged. The peak flows decrease from 1 to 8 cfs as a result of the Bonneville Unit. At 2100 South Street, there would be no change in the dry year average monthly flows, and in the wet year condition, the percentage change would range from a 40 percent decrease in July to an 80 percent increase in April. Flows would increase at 2100 South Street for the average years from January through March and for the wet year in February and March.

These decreases in flows are not expected to have any adverse impacts on wetlands since overbank flooding, needed to support adjacent floodplain wetlands, would still occur. Along some reaches of the river, the decrease in flows may be beneficial in stabilizing the channel and decreasing erosion. In particular, the slightly reduced flows may promote additional riparian vegetation establishment along areas normally subject to a higher flow regime. Along other reaches where adjacent oxbows and cut-off channels support riparian habitat, the decrease in flows during the spring is not expected to adversely affect the habitat since higher flows (presumably overbank flood flows) would occur during January and February to correspond with natural peak runoff periods. There may be some shifts in the riparian communities in response to the slightly modified hydrologic regime, but the shifts are not expected to result in a permanent loss of wetland habitat.

2.3.3.4 Wildlife Resources

2.3.3.4.1 Utah Lake. The wildlife habitat surrounding Utah Lake includes open water, wetland, foothill shrub, grassland, desert shrub, and meadow habitats. These habitats combined provide important habitat for amphibians, reptiles, waterfowl, shorebirds, wading and other aquatic birds, raptors, upland game birds, passerine and other small birds, and mammals.

Amphibians in the vicinity of Utah Lake are generally associated with wetland habitats such as marshes, springs, streams, ponds, and wet meadow/pasture habitats. The perimeter of Utah Lake supports several species of reptiles. The largest numbers of reptiles probably occur within the desert shrub habitats that exist near the steep shoreline on the west side of the lake.

Utah Lake is a very important area for ducks and geese in central Utah. Primary waterfowl use areas (and hunting areas) include Provo Bay, Goshen Bay, Powell Slough, Benjamin Slough, and the north shore. Although substantial numbers of waterfowl nest at Utah Lake, its greatest importance is as a resting and feeding area for migratory birds from nearby states and Canada. Open water areas are used extensively for resting, while marsh and meadow habitats provide food and nesting cover. Winter use of Utah Lake by waterfowl is restricted to open water areas that are kept ice-free by thermal springs.

Shorebirds, wading birds, and other aquatic species are seasonally common in wetland habitats throughout the Utah Lake area. Shorebirds and wading birds utilize Goshen Bay more than any other area around Utah Lake (Huener et al. 1994). A large number of other aquatic species occur and nest in the area.

Areas of particular importance for shorebirds, wading birds, and other aquatic species include Powell Slough State Waterfowl Management Area, Provo Bay, Benjamin Slough, and Goshen Bay. The west side of the lake provides very little habitat. Marshes, open water, flooded tamarisk, and wet meadow are used extensively during spring and early summer. Some species frequent flooded pastures and croplands for feeding from early spring to late summer. Preferred nesting habitats include marsh, tamarisk, saline meadow, and deciduous woodlands. During late summer, expansive shallows and mud flats attract large concentrations of feeding birds.

Bird Island (also known as Rock Island) has historical importance as a nesting and resting habitat for a large number of waterbirds. However, rising water levels completely inundated the island in the 1970s, and annual fluctuations in lake levels now result in repeated cycles of exposure and inundation. Records from the 1940s indicate that six bird species formerly nested on the island, including nearly 70,000 California gulls (*Larus californicus*) and large numbers of white pelicans (*Relecanus erythrorhynchus*) (Pritchett, Frost, and Tanner 1981).

The wetlands, grasslands, and woody plant communities surrounding Utah Lake provide breeding and foraging habitat for several species of raptors. In addition, several upland game birds and a diverse assemblage of passerine and other small birds also use the Utah Lake area for nesting, cover, and foraging. Likewise, the habitats present also provide important habitat for small mammals, including furbearing species. Mule deer (*Odocoileus hemionus*) is the only large wild mammal species in the vicinity of Utah Lake. They use tamarisk and other wooded areas on the northern, eastern, and southern portions of the lake, while sagebrush (*Artemesia* spp.)is the preferred habitat on the west side of the lake (Shields and Moretti 1982). Very few individuals are resident, and there is little potential for a significant population.

2.3.3.4.1.1 Impacts. The predicted changes in the surface water elevation or the water quality would not modify any habitat communities present; therefore, no impacts would occur to wildlife species that use the habitats in and immediately surrounding Utah Lake.

2.3.3.4.2 Jordan River. The Jordan River corridor originates at the north end of Utah Lake, then extends 54.2 miles northward to the Great Salt Lake. The upper end of the river corridor between Utah Lake and Bluffdale still retains a fairly natural willow and cottonwood tree-lined channel along much of its length (Holden and Crist 1987). Above the immediate riparian corridor, sagebrush/grass and bitterbrush/grass habitats occur along with agricultural fields. This southern portion of the Jordan River provides habitat to reptiles, waterbirds, raptors, upland game birds, passerine birds, mule deer, and mammalian predators such as skunks (*Mephitis* spp.) and coyotes (*Canis latrans*).

Downstream of Bluffdale, much of the Jordan River has been dredged and channelized to improve the carrying capacity of the river and reduce flooding of nearby residential property. Riparian vegetation is sparse and wildlife habitat is restricted by cultivated fields and suburban housing. Reptiles, limited numbers of waterbirds, and small mammals, such as skunks, are the predominant wildlife occupying this habitat, which extends north to the Surplus Canal near 2100 South Street.

The Surplus Canal below 2100 South Street drains most of the Jordan River water to the Great Salt Lake. The dominant bank cover type along the canal is riprap; however, the lower portion of the canal has banks that are typically bare or covered with grasses and small shrubs (Filbert and Holden 1992). Surplus Canal overflow water allowed to spill over a low section of dike enters the Goggin Canal, which also drains into the Great Salt Lake. Bank cover along the Goggin Canal consists primarily of riprap or bare silt and occasional woody vegetation (Filbert and Holden 1992). The natural channel of the Jordan River downstream of the Surplus Canal has banks vegetated mostly with grasses and patches of riparian trees and shrubs. The river from North Temple downstream underwent extensive bank modification and dredging in the early 1980s (Holden and Crist 1987).

The habitats associated with the canals and river channel described above support reptiles and limited numbers of waterbirds, raptors, and mammalian predators. The greater habitat value is provided by the wet meadows and seasonally flooded saline wet meadow/marshes common to this lower end of the Jordan River corridor. These

extensive wetlands support large numbers of waterbirds, both resident and migratory, and are of primary importance for waterbird feeding, breeding, and nesting.

2.3.3.4.2.1 Impacts. The operation of the Bonneville Unit would result in about a 22 percent reduction in monthly flows upstream of the Jordan Narrows and virtually no change in flows at 2100 South Street. This 22 percent flow reduction would result in slightly less open water habitat within the upper river corridor, but not enough to impact the baseline conditions of riparian vegetation and wildlife. There would also be no impact to riparian vegetation or wildlife from the negligible change in salinity from that of baseline conditions.

2.3.3.5 Aquatic Resources

2.3.3.5.1 Utah Lake

2.3.3.5.1.1 Aquatic Invertebrates and Fish. Utah Lake is a highly productive ecosystem with the majority of production occurring as massive blue-green algal "blooms" late in the summer and fall. Most of the blue-green algae species present are nuisance algae that cause various water quality problems in other eutrophic systems. Algae production is somewhat limited by the high turbidity of the lake water, which reduces various water quality problems. The algal communities differ significantly among the different lake segments and substrates.

Although extreme seasonal fluctuations in algal populations occur in Utah Lake, the availability of adequate biomass of algae does not appear to be limiting to the other biota. Zooplankton (free-floating microorganisms) and possibly other invertebrates respond to fluctuations in algal biomass; however, other environmental factors such as sedimentation, substrate, temperature, and water level fluctuations appear to have a greater impact on their distribution and abundance than does algal biomass.

Zooplankton species are prolific in Utah Lake. The highest numbers occur in the summer and late fall. The lowest numbers are present during the winter and immediately after ice cover. Provo Bay has the highest concentrations of zooplankton. The main lake and Goshen Bay have similar concentrations.

The rocky shore areas of the lake, particularly the large rubble areas, have the highest densities of macroinvertebrates. The Goshen Bay shore is highly diverse in habitat types, harboring high densities of macroinvertebrates. The rocky shore and emergent vegetation communities in Goshen Bay differ significantly from those in similar habitats in other areas of Utah Lake.

2.3.3.5.1.2 Game and Non-Game Fisheries. Utah Lake has historically provided a valuable fishery resource. Sampling of the lake in the late 1970s found that carp (*Cyprinus carpio*) was the primary fish species present with white bass (*Morone chrysops*) also comprising a large percentage of the fishery. Other species including channel catfish (*Ictalurus punctatus*), walleye (*Stizostedion vitreum*), and black bullhead (*Ictalurus melas*) are also present.

The main lake segment forms the largest area in Utah Lake and supports the largest number of fish. It has the deepest water and contains the most extensive open water habitat in the lake. The three major tributaries to Utah Lake (Provo River, Spanish Fork River, and Beer Creek) enter the main lake.

Goshen Bay is second only to the main lake in the proportion of the lake fishery it supports. Its physical and fishery characteristics are most similar to the main lake. Combined, the main lake and Goshen Bay sustain the adult fish population of Utah Lake. Relative abundance of adult white bass, walleye, and channel catfish in Goshen Bay is similar to that of the main lake. Adult fish move into the shallows of Goshen Bay during the spring and summer to feed and spawn. In the fall and winter, adults move from shallow areas of the bay into the main lake or into deeper water in the northern portion of the bay.

Provo Bay is the smallest of the three lake segments and supports the smallest proportion of fish. However, Provo Bay is the most important of any area of Utah Lake as a nursery area for young fish; young fish move into Provo

Bay in summer and fall. Provo Bay is the least important lake segment to adult white bass and walleye because of the lack of rocky habitat. Adult black bullhead densities in the fall are greatest in Provo Bay, while channel catfish densities are similar to other lake segments. Carp densities are extremely high in the bay in the spring when carp are spawning. Each year, a post-spawning concentration of June suckers (*Chasmistes liorus*) develops in Provo Bay, possibly as a result of the abundant food resources of the bay.

2.3.3.5.1.3 ***Commercial Fisheries.*** Although three fishermen had permits in 1993 to commercially fish Utah Lake, two appear not to have had active operations because they failed to file an annual report of their catch. The primary commercial fishing of Utah Lake is conducted by the Loy family, which has fished the lake commercially for four generations.

The great majority of the Utah Lake fish taken commercially are carp. Although white bass and bullhead are permitted to be taken during specific years, the white bass harvest has amounted to only about 0.5 percent of the total catch. In the past several years, the annual harvest of carp has ranged from 6 to 1,000 tons. Although commercial fishing occurs year-round, the majority of carp harvest occurs during the cooler months, with the peak occurring from November through April. This includes fishing through the ice, because the lake is generally frozen from mid-December through mid-March or the beginning of April.

2.3.3.5.1.4 ***Angling Use and Fisheries Management.*** Fishing pressure at Utah Lake has increased noticeably in recent years, with the popularity of warmwater fishing in Utah placing greater demands on these waters. Spring walleye and white bass angling have become increasingly popular, attracting large numbers of fishermen to the lake from March into May. Fishing pressure declines in the summer, but white bass, channel catfish, and black bullhead support substantial angler use throughout this period. Fishing pressure is generally light during the fall. In recent years, ice fishing for white bass has grown in popularity. The lake is currently rated by the State as a Class II fishery. Class II lakes are important to the Utah economy because of their recreational value. Productivity in these lakes is such that they support high fish populations, in good condition, of one or more species of game fish. Future game fish angler use on the lake without Bonneville Unit conditions is estimated at about 110,000 angler-days per year (USBR 1987b).

Fishery management objectives for Utah Lake have not yet been completely developed, but all actions considered must first be evaluated for their potential impact to the June sucker, an endangered fish occurring in the lake. These management objectives would be consistent and coordinated with actions and activities described in the June Sucker Recovery Plan (FWS 1995d).

2.3.3.5.1.5 ***Impacts.*** Operation of the Bonneville Unit would not result in a measurable change in Utah Lake's level of pesticides, heavy metals, or other trace elements as a result of increased return flow or direct delivery of water. Therefore, there is no risk of water quality impacts to aquatic biota from changes in these constituents. Changes in nutrient loading is not an impact risk, since turbidity levels in the lake prevent the lake's presently high levels of nutrients from causing excessive algal blooms.

As shown in Table 2-7, average lake levels would result in an average annual salinity concentration approximately 8 percent higher with operation of the Bonneville Unit than would occur without the Bonneville Unit (1,142 ppm versus 1,237 ppm). During low water years, the average annual TDS level would be 7 percent lower than baseline conditions and, during wet years, would be 11 percent higher than baseline conditions. All of these concentrations are within the range of the lake's historical monthly salinity levels (694 ppm to 5,540 ppm). TDS levels of 2,000 ppm would generally not harm freshwater fish and other aquatic life; limiting concentrations of TDS are normally in the range of 5,000 to 10,000 ppm for freshwater fish (McKee and Wolf 1963). Therefore, the anticipated average increase in TDS resulting from operation of the Bonneville Unit would not have a significant impact upon fisheries. Bonneville Unit operations would potentially benefit fisheries during the lowest water level months of drought years.

It is possible that the Bonneville Unit-induced increase in average salinity may cause a shift in the species composition of the lake's population of phytoplankton. Phytoplankton (diatom) studies in Utah Lake (Eyring Research Institute and BYU 1982) have shown the same species of plankton occur in the main lake, which has relatively low TDS, and in Goshen Bay, which has relatively high TDS. However, the dominant species of phytoplankton vary between these portions of the lake. The same study found that zooplankton densities between Goshen Bay and the main lake were quite similar, but that Provo Bay, a somewhat fresher part of the lake, had higher zooplankton densities. This information suggests that higher TDS may not change the plankton community substantially, but more of the lake would have the community structure presently seen in Goshen Bay. Provo Bay would likely not be impacted as severely by increased TDS, because it is separated from the main lake and would remain that way. This information, along with the fact that TDS has fluctuated considerably in the lake in the past, suggests that plankton food sources for zooplankton and fish would not be altered sufficiently to impact the lake's fisheries.

It is, however, important to note that because of the dynamics of the lake, changes in one community could cause changes throughout both the plant and animal communities. If the structure of the plankton community changes, then the proportion of fish species within the lake could change, which in turn could balance or exacerbate previous changes. For example, if changes caused an increase in carp (which tend to root around in lake bottoms and dislodge vegetation), turbidity could increase, which could decrease plant and phytoplankton growth, which in turn would decrease food sources for zooplankton and for fish such as bass and bluegill. This could impact June suckers both negatively and positively. Because of the complex dynamics, exact effects throughout lake populations are difficult to ascertain, but significant changes are not expected to occur.

Based on the baseline and SFN System water levels for average conditions, the operation of the Bonneville Unit would result in no significant change to the water elevations of Utah Lake. Project operations would reduce average annual water level fluctuations from about 2.8 feet to 2.5 feet. On those occasions of drought such as 1935, the low water elevations would be less severe under future-with-SFN System conditions. The average surface acreage for this 44-year period is virtually the same for baseline conditions and project operations.

The effect of these changes on the non-game, game, and commercial fisheries would be negligible because average surface acreage of shallow water spawning and nursery habitat (Provo Bay and Goshen Bay) for carp, black bullhead, largemouth bass (*Micropterus salmoides*), bluegill, and yellow perch (*Perca flavescens*) would be sustained at baseline levels. The Bonneville Unit's 0.13-foot (1.6-inch) lower water level during spring and summer is not expected to have an effect on these fisheries. The 0.3-foot (3.6-inch) reduction in water surface fluctuation with the operation of the Bonneville Unit should have a beneficial effect on Utah Lake fisheries.

Provo and Goshen Bays also support high densities of zooplankton that form the prey base for young fish. The small (less than 0.4 feet) reduction in spring and summer water levels with the Bonneville Unit would result in a slight lessening of the baseline acreage of useable wetted habitat for young fish in these shallow embayments. However, this should be offset by the Bonneville Unit's raising of the annual low elevation (September and October) by 0.2 feet (2.4 inches). This benefit to aquatic biota would be particularly pronounced during drought years when the fall period lake elevation would be higher. The Bonneville Unit's reduction of water level fluctuation would also benefit Utah Lake fish of all sizes and species.

2.3.3.5.2 Jordan River. The Jordan River originates from the outflow of Utah Lake. At intervals along its length, flows from the Jordan River are diverted and then replenished from seepage, wastewater discharge, and irrigation return flows. The largest diversions occur at the Jordan Narrows, located about 10 miles north of Utah Lake near the Utah-Salt Lake county line. Below the Jordan Narrows, the river continues north another 44.2 miles before entering the Great Salt Lake through its natural channel, the Surplus Canal, and the Goggin Canal.

2.3.3.5.2.1 Physical and Chemical Characteristics and Instream Habitat. The outflow from Utah Lake to the Jordan Narrows includes releases to meet historical irrigation and industrial demands in northern Utah County and Salt Lake County. Spills or flood control releases occur when the lake reaches and exceeds compromise level.

At compromise elevation, the discharge to the Jordan River is 1,500 cubic feet per second (cfs). At elevation 4,492 feet, the discharge would be about 2,500 cfs. Baseline average monthly flows for the Jordan River at the Narrows and 2100 South Street are shown in Tables 2-5 and 2-6, respectively.

Water quality at the Jordan Narrows is controlled primarily by the water quality of Utah Lake. The reach of the Jordan River from Utah Lake to the Jordan Narrows has been reclassified 1C by the Utah Water Pollution Control Committee. A 1C classification is defined as water protected for domestic purposes with prior treatment by treatment processes as required by Utah Department of Health.

The upper 10-mile section of the Jordan River to the Jordan Narrows is slow and meandering. The channel is wide and was dredged in the mid-1980s to increase its capacity for release flows from Utah Lake. Like Utah Lake, the river carries a high silt and nutrient load, and the substrate is primarily adobe clay, with silt in the backwaters.

The lower portion of the Jordan River (the Jordan Narrows to the Great Salt Lake) begins with the diversion of most of its flow at 9400 South Street. It then gains in flow as a result of seepage, tributary inflow, and storm drain inflow until the average monthly winter flow at 2100 South Street is six times greater than the flow at the Jordan Narrows (see Tables 2-5 and 2-6). Entering the south shore area of the Great Salt Lake, the Jordan River flows through a large marsh that serves as a waterfowl management area.

The lower Jordan River between 3300 South Street and 1000 North Street varies between natural meandering channels with riparian vegetation to channelized portions with riprap. Silt, sand, and gravel are the predominant substrates with silt increasing in prevalence as the river flows north (Filbert and Holden 1992). The river is characterized by silt, relatively warm temperatures, and low current velocities.

2.3.3.5.2.2 Aquatic Biota. The benthic invertebrate fauna of the upstream section of the Jordan River is dominated by silt-tolerant chironimid larvae and oligochaetes, with a predominance of filter-feeding organisms such as the caddisfly larvae (*Hydropsyche* sp.) and the chironimid larvae (*Polypedilium* sp.) in the limited riffle habitat. Downstream of Riverton, invertebrate populations are dominated by midge larvae (*Chirononidae*) and oligochaete worms. Densities are only 5 to 38 percent of that found in the upper river (Holden and Crist 1987). This low density of invertebrates (7 to 133 organisms per square foot between Bluffdale and North Temple) is typical of southwestern rivers with unstable substrates dominated by sand and silt.

The main fish species occurring in the upper river above the Jordan Narrows are Utah sucker, carp, black bullhead, channel catfish, and some white bass and walleye from Utah Lake (IABAT 1988). Angler use is heavy during the spring and summer months (IABAT 1988). This section is classified by the Utah Division of Wildlife Resources as a Class III fishery. Class III fisheries are important because they support the bulk of stream fishing pressure in Utah.

Within the upper section of the Jordan River are areas where accretion flows lower temperatures sufficiently to support trout. The greater the releases of warm water from Utah Lake during the summer irrigation season, the higher the water temperature becomes in these pockets of cool accretion inflow. Although this is not evident in the monthly average flows shown earlier in Table 2-6, there is typically no outflow from Utah Lake for the period of December through March during dry years. Although accretion flows eventually provide aquatic habitat downstream, this lack of year-round flows is a limiting factor for the aquatic biota of the upper Jordan River.

In the lower Jordan River north of 3300 South Street to Great Salt Lake, the most abundant fish are carp and Utah sucker, with small numbers of game fish (Filbert and Holden 1992). The most common game fish species are walleye, white bass, and green sunfish (*Lepomis cyanellus*), but other game fish present include black bullhead, channel catfish, black crappie, largemouth bass, smallmouth bass (*Micropterus dolomieui*), yellow perch, and an occasional brown trout (*Salmo trutta*) or rainbow trout (*Oncorhynchus mykiss*) in the spring before the waters warm. Physical habitat conditions are poor throughout the lower river and there is little reproduction of game fish

(Filbert and Holden 1992). Fish abundance appears to be limited more by physical habitat than by water quality as fish are most numerous where riprap on the stream banks provide cover (Filbert and Holden 1992). Much of the river is shallow and channelized and has a shifting substrate of sand and silt.

2.3.3.5.2.3 Impacts. During average water years, operation of the Bonneville Unit results in most months averaging a 10 to 30 percent flow reduction in the Jordan River at the Narrows from baseline conditions (see Table 2-5). Wet- and dry-year conditions would produce a similar level of flow reduction for most months. Assuming that springs and accretion flows sustain fish in pool habitat scattered throughout the Jordan River above the Narrows, the reduction in summer months could potentially benefit this fishery. Utah Lake discharges are warmer than the spring inflow to this reach, and this reduction in flow may help to sustain cooler temperatures without a significant loss of physical habitat. Otherwise, the limiting factor for the river during low water years would be lack of year-round flows, and the frequency of no-flow months would not change from baseline conditions as a result of the operation of the Bonneville Unit. The reduction in Utah Lake water discharged to the Jordan River during the irrigation season would result in reduced bank erosion and is unlikely to have an effect on fisheries from a loss of fish habitat because of the channel shape and substrate conditions.

Under Bonneville Unit operations, the lower Jordan River at 2100 South Street would have no significant change in flow from baseline conditions (see Table 2-6). The fisheries of the lower Jordan River would not be affected by these minor flow changes.

Salinity changes in the Jordan River resulting from Bonneville Unit operations are shown in Table 2-9. Above the Jordan Narrows, Jordan River salinities would increase an average of 6 percent (maximum salinity of 990 ppm TDS), and the monthly range of increase would be 4 to 8 percent. The lower Jordan River at 2100 South Street would experience an average salinity increase over baseline of 2 percent (maximum salinity of 1,158 ppm TDS) with a range of zero to 3 percent increase. These salinity increases are well within the 2,000 ppm TDS limit for trout, which are the most water quality-sensitive of the fish occurring in the lower Jordan River. Bonneville Unit operations water quality would have no effect on the fisheries of the Jordan River.

2.3.3.6 Special-Status Species

The U.S. Fish and Wildlife Service (FWS) identified six special-status species that are either known to occur or have the potential to occur in the vicinity of Utah Lake, including the Jordan River from the outlet to the Great Salt Lake. These species are listed in Table 2-10. For purposes of the following discussion, the status, distribution, and impact analysis for Utah Lake and the Jordan River are discussed together.

2.3.3.6.1 Ute Ladies'-Tresses

2.3.3.6.1.1 Distribution. Two populations of Ute ladies'-tresses occur near Utah Lake in the wet meadows at Powell Slough and near the city of American Fork. Based upon two recent surveys, the combined size of these populations is estimated at a maximum of 250 individuals, although only 70 flowering individuals were observed in 1994 (Stone 1993, Franklin et al. 1995). Both populations occur outside of the shoreline subject to annual water level fluctuations and appear to be supported by spring seepage, particularly the American Fork population, which is located more than 2 miles from the lakeshore (England 1994).

Table 2-10
Special-Status Fish, Plants, and Wildlife Species with Potential to Occur Within the Utah Lake and Jordan River Impact Area of Influence

Common Name	Scientific Name	Status[a]
Fish Species		
June sucker	*Chasmistes liorus*	E
Plant Species		
Ute ladies'-tresses	*Spiranthes diluvialis*	T
Aquatic and Terrestrial Wildlife Species		
Utah valvata snail	*Valvata utahensis*	E
Spotted frog	*Rana lutreventris*[b]	C
Bald eagle	*Haliaeetus leucocephalus*	T
Peregrine falcon	*Falco peregrinus*	E

[a]Status Definitions: T = Listed as threatened under the Endangered Species Act (ESA) of 1973, as amended.
E = Listed as endangered under ESA.
C = Candidate for listing under ESA.
[b]The scientific name of the spotted frog was recently changed from *Rana pretiosa*.

Both the American Fork and Powell Slough colonies appear to occur in spring-fed habitats above the maximum elevation of Utah Lake. The population of Ute ladies'-tresses that occurs at the American Fork site is found within a small farm pasture that is grazed primarily by horses. The vegetation is a mix of wet meadow grasses, sedges, and forbs. The site is currently heavily grazed with less than 2 inches of stubble observed in fall 1994. At the Powell Slough site, the Ute ladies'-tresses occupy the margins of a native grass hay field dominated by bluegrass (*Poa* sp), rushes (*Juncus* spp.), and wiregrass (*Juncus articus*). Portions of this habitat are somewhat atypical for the species, in that the site is dominated by a peat layer or a layer of partially decomposed organic matter. However, Ute ladies'-tresses does, on occasion, occur under similar conditions (FWS 1995c). Additional information on the life history and habitat requirements for the Ute ladies'-tresses is found in Section 3.7, Special-Status Species.

2.3.3.6.1.2 ***Impacts.*** Both of the Ute ladies'-tresses populations located near Utah Lake occur at an elevation above 4,500 feet, which is about 10 feet above the average annual maximum elevation of Utah Lake under operation of the Bonneville Unit. Thus, both populations are located out of the zone subject to lake level fluctuation and would not be subject to either increased inundation or drought stress as a result of the Bonneville Unit operation.

The moist soil conditions required by the species appear to be provided by a series of springs that discharge above the maximum extent of Utah Lake (England 1995). These springs are fed by an aquifer with a strong gradient towards the lake and a negligible groundwater outflow from the lake. A slight increase in Utah Lake levels during low water conditions and virtually no change in lake levels during high water conditions above that which occurs under baseline conditions would not have a measurable effect on groundwater levels or on the discharges from springs that occur above the maximum extent of Utah Lake. Because no changes are anticipated to the current springflow supporting the American Fork and Powell Slough Ute ladies'-tresses populations as a result of the operation of the Bonneville Unit, there would be no adverse impacts to these populations.

2.3.3.6.2 June Sucker

2.3.3.6.2.1 Distribution. June suckers are found only in Utah Lake and the lower Provo River. Once a very common species, it was listed as endangered by the FWS in 1986 with 4.9 miles of the lower Provo River designated as Critical Habitat (Gutermuth and Lentsch 1992).

When Euro-American settlers first arrived in Utah Valley, fish runs from Utah Lake into tributaries were a major source of food in the spring and early summer. The June sucker, as its name implies, ran up the tributaries in June, following earlier runs of cutthroat trout (*Oncorhynchus clarki*) and Utah sucker. June suckers were extremely abundant in the 1800s, prompting one early ichthyologist to call Utah Lake "the greatest sucker pond in the Universe" (Jordan 1891 cited by Bio/West 1994). Thousands of suckers were often trapped in irrigation diversions during the spawning runs, and a commercial fishery for them existed well into the 1900s (Carter 1969 cited by Bio/West 1994).

June sucker numbers dropped dramatically in Utah Lake in the early 1900s. A major factor in the decline of the species was irrigation practices in tributaries used for spawning, such as the Provo River, Spanish Fork River, and Peteetneet Creek. Irrigation water diversions nearly totally dewatered these streams at times during many years in the late 1800s, reducing potential spawning habitat. In addition, irrigation diversions in these tributary streams blocked upstream movements of adults and diverted them into agricultural fields (Carter 1969 cited by Bio/West 1994). Excessive commercial fishing also contributed to this decline.

In addition to impacts on spawning streams, Utah Lake was also changing. Water quality (i.e., turbidity increases) was reduced as a result of the settlement of the Utah Valley (White et al. 1969 cited by Heckman et al. 1981), and a number of exotic fish species were introduced into the lake and streams. These included common carp, channel catfish, and largemouth bass. These species either preyed on young suckers or competed for space and resources with young and adult suckers. Utah Lake was also being increasingly used as an irrigation reservoir, and annual lake fluctuations were increasing compared to natural conditions. The lake likely fluctuated 1 to 2 feet annually in the late 1800s, but this increased to nearly a 4-foot annual fluctuation by the mid-1900s (Bio/West 1994). The combination of increased lake level fluctuations and increased numbers of carp (which tend to root around in lake bottoms dislodging vegetation and causing increased turbidity) likely reduced available cover for young suckers and other small fish.

During the 1930s, when a major drought occurred in Utah, Utah Lake was pumped to its lowest recorded level by water users. The low level of the lake apparently resulted in a large die-off of June sucker and other species (Tanner 1936 cited by FWS 1995d). During this period, it is hypothesized that the June sucker hybridized with the Utah sucker, resulting in a distinct subspecies of hybrid origin that persists today (Miller and Smith 1981 cited by FWS 1995d).

June sucker were still fairly common in Utah Lake in the 1950s, but declined noticeably in the 1960s and 1970s. Studies by Arnold (1959), White and Dabb (1970), and Radant and Sakaguchi (1980) (all are cited by FWS 1995d) attributed this decrease to the introduction and population increase of white bass, a likely major predator on young and juvenile suckers. The lack of cover caused by carp and increased lake level fluctuations likely contributed to the effectiveness of white bass at removing not only young June sucker, but other native species such as Utah chub (*Gila atraria*), which were also abundant in the lake until white bass arrived (Radant and Sakaguchi 1980). Another factor that may have contributed to this recent decline was extremely low flow in the lower Provo River resulting from water management during drought periods in 1950s and 1960s. Flows in the lower Provo River during 1954, 1955, 1959, and 1960 were close to zero during the spawning period (Bio/West 1994). Recent studies (Gutermuth et al. 1993; Gutermuth and Lentsch 1992) have shown that such low flows have caused a loss of reproduction and even death of adults from dissolved oxygen depletion.

During the 1990s, fewer than 100 adults have been recorded annually in the lower Provo River during spawning runs, including both June and Utah suckers. The June sucker appears very near extinction, and recruitment to the

adult population is very low because of larval predation by white bass and other introduced predators (Bio/West 1994).

During June, adults move into the Provo River to spawn. They are limited to the lower 4.5 miles by an irrigation diversion structure. Spawning typically occurs in mid- to late June, with the eggs hatching in 1.5 to 2 weeks. Adults move back into the lake shortly after spawning. A post-spawning aggregation of adult June sucker was found in Provo Bay by Radant and Shirley (1987 cited by FWS 1995d). This portion of Utah Lake had higher plankton densities during this period and the fish may have been responding to this food source following relatively little feeding during their stay in the Provo River.

The Provo River, the largest tributary of Utah Lake, has historically been the major spawning tributary for June sucker, but other tributaries were likely used prior to changes that made them unavailable or unsuitable for the species. Carter (1969 cited by Bio/West 1994) notes that early explorers and indigenous Indians also fished on the lower Spanish Fork River, Hobble Creek, and the mouth of Peteetneet Creek. All three of these streams have considerably reduced flows from pre-irrigation times. Radant and Sakaguchi (1980) noted adult June sucker in spawning condition near the mouth of the Spanish Fork River, but later studies failed to find either spawning suckers or suitable habitat in that stream. The lowermost irrigation diversion structure on the Spanish Fork River prevents the species from accessing potential spawning habitat (Radant and Shirley 1987). Peteetneet Creek no longer reaches Utah Lake, but is totally dewatered near the High Line Canal (see Map 1-1). Flow in Hobble Creek is also very reduced and the creek no longer provides suitable habitat for a large species such as the June sucker.

Factors that have contributed to the reduction in June sucker numbers include changes that have occurred both in Utah Lake and in historical spawning tributaries. In the Provo River, these impacts include water management (primarily irrigation use) that has reduced or fluctuated streamflows during critical spawning times, irrigation diversions preventing access to upstream spawning habitat, channelization and loss of protective habitat for larval outmigrants, and the introduction of exotic predators. In tributaries other than the Provo River, all spawning habitat has been lost because of reduced flows and stream blockage. In Utah Lake, factors include changes in chemical and physical habitat, introduction of exotic predators, and lake level management.

2.3.3.6.2.2 Impacts. Reduced Utah Lake water levels or increased water level fluctuations are conditions that, if substantially different from baseline conditions, could significantly impact the June sucker population of the lake. Lower water levels could impair June sucker spawning migrations into the Provo River, and water level fluctuations limit the growth of aquatic plants that could provide cover for young-of-the-year June sucker.

In contrast to the 1987 Proposed Action for the Irrigation and Distribution (I&D) System (USBR 1987b) in which 500 acres of open water habitat would be lost (and in which there was a determination of no effect for June sucker in Utah Lake), the primary effect of the Bonneville Unit operation as it relates to June sucker would be to maintain Utah Lake at an average long-term elevation similar to that which occurs under baseline conditions, only slightly increasing open water habitat, but reducing the range of annual fluctuations by 0.3 foot (see Table 2-4). During the June sucker's June spawning and July outmigration period, water elevations in Utah Lake would average 0.2 foot lower than baseline under Bonneville Unit conditions, but the distance from open water to the shoreline would be slightly reduced in drought (low water) years. The low water months of September and October under average conditions would be approximately 0.3 foot higher with the Bonneville Unit than under baseline conditions.

The greatest lateral changes in water levels would occur in Provo Bay and Goshen Bay. For example, under baseline conditions, the lake level in Provo Bay draws down to the point of essentially eliminating open water within Provo Bay. This condition produces distances of 2,000 feet to 9,500 feet between open water and the lake shoreline wetlands in Provo Bay. Under Bonneville Unit conditions, the amount of open water within Provo Bay during the average annual low water condition would increase, but only slightly. High water conditions would

be nearly the same under both baseline and Bonneville Unit conditions. The extreme high water, such as occurred as a result of the 1952 and 1983 floods, would still occur.

Reductions to both annual and long-term fluctuations would be generally beneficial to June sucker relative to habitat stability, prey, and migration for reproduction. The slightly higher lake elevations and reduced distance from open water to the shoreline in drought years resulting from Bonneville Unit operation would marginally improve the accessibility of the mouth of the Provo River to spawning June suckers.

Bonneville Unit operations impacts to June sucker would be adverse if salinity in Utah Lake increased to a level that would impair any life stage of the June sucker or reduce its primary prey items (phytoplankton). Although the salinity level that would potentially have an adverse effect on any of the life stages of the June sucker is unknown, it is assumed to be levels in excess of 8,000 ppm based on the past history of the lake and the McKee and Wolf (1963) statement that limiting concentrations of TDS for most fish species are in the range of 5,000 to 10,000 ppm.

The Bonneville Unit operation studies predict an 8 percent increase in average annual salinity over baseline conditions, increasing from 1,142 to 1,237 ppm (see Table 2-7). On a seasonal basis, this change would range from a 12 percent increase (1,073 to 1,201 ppm) in June to a 5 percent increase (1,302 to 1,368 ppm) in October. In September, the month with the highest average salinity under baseline conditions, average salinity increases by approximately 6 percent (1,301 to 1,377 ppm).

Although the Bonneville Unit operation would increase average TDS values by 8 percent, the operation would reduce peak salinity by up to 24 percent during low water years when monthly salinity historically is the highest, potentially providing a slight benefit to the June sucker. These effects (i.e., increased average salinity but reduced extremes) are similar to those described in the 1987 Biological Assessment (USBR 1987c) in which a no effect determination was made for June sucker in Utah Lake. The TDS levels in Utah Lake under the Bonneville Unit operation would be less than 5,000 ppm even during low water conditions, which typically produce the highest salinities. This TDS value is below the level indicated by McKee and Wolf (1963) as limiting to many fish species. Little is known about the tolerance level of June sucker to higher TDS values, but its having evolved in a desert system suggests the species likely has a fairly high tolerance of elevated salinity levels and should not be adversely impacted by the Bonneville Unit salinity conditions.

It is possible that the Bonneville Unit-induced increase in average salinity might cause a shift in the species composition of the lake's phytoplankton community. Phytoplankton (diatom) studies in Utah Lake (Utah Lake Research Team et al. 1982) have shown the same species of plankton occur in the main lake, which has relatively low TDS, and in Goshen Bay, which has relatively high TDS. The dominant species of phytoplankton, however, varies between these portions of the lake. The same study found that zooplankton density between Goshen Bay and the main lake were quite similar, but that Provo Bay, a somewhat fresher part of the lake, had higher zooplankton densities. This information suggests that higher average TDS and the lower salinities in low water years may not change the species of plankton present. It is possible more of the lake would have the community structure presently seen in Goshen Bay. Provo Bay would likely not be impacted by the increased TDS as much as the main body of the lake because it is separated from the main lake and would remain that way. This information, along with the fact that TDS has fluctuated considerably in the lake in the past, suggests that plankton food sources for zooplankton and fish would not be altered sufficiently to impact the lake's June sucker population.

2.3.3.6.3 Utah Valvata Snail

2.3.3.6.3.1 Distribution. The Utah valvata snail (*Valvata utahensis*) is listed as endangered. The type specimen for the species was collected in 1884 from Utah Lake near Lehi and the headwaters of the Jordan River (Call 1884, Clarke 1991). Despite extensive surveys throughout the state (Clarke 1991), no living specimens have been

recorded in Utah since collection of the type specimen. The species may, however, still be present in the freshwater springs around the margin of Utah Lake (Stone 1994).

The Utah valvata snail prefers free-flowing, clear, cool water associated with large spring complexes. The species avoids areas with heavy currents or rapids. Preferred habitats have well-oxygenated water with calcareous mud/mud-sand substrate among beds of submergent aquatic vegetation.

2.3.3.6.3.2 Impacts. Potential spring-fed habitat for the Utah valvata snail may occur near Utah Lake. However, these springs discharge above the maximum elevation of the lake. These springs are fed by an aquifer with a strong gradient toward the lake and a negligible groundwater outflow from the lake. A 1- to 2-foot change in Utah Lake levels would not have a measurable effect on groundwater levels or on the discharges from springs that occur above the maximum extent of Utah Lake. Likewise, changes in lake salinity would not affect springs upgradient of Utah Lake. Because no changes are anticipated to the current springflow supporting potential suitable Utah valvata snail habitat, there would be no adverse impacts to this species as a result of operation of the Bonneville Unit.

2.3.3.6.4 Spotted Frog

2.3.3.6.4.1 Distribution. The spotted frog (*Rana lutreventris, formerly Rana pretiosa*) is a candidate species for listing (FWS 1994d). Numbers of this species have declined substantially in recent years throughout its range primarily because of loss and degradation of aquatic habitats. The range of this species extends from extreme southeastern Alaska south through western Canada, western Wyoming, Idaho, Utah, Nevada, Oregon, and Washington (Stebbins 1985). The Utah Division of Wildlife Resources (1997d) has issued a draft Conservation Agreement and Strategy for the species, which if implemented, could significantly reduce or eliminate threats that warrant listing.

Several studies of spotted frog distribution in Utah have been performed in recent years (Hovingh 1988, 1993; Ross et al. 1993). During the 1994 surveys conducted for the SFN System, spotted frogs were identified at several wetland locations in Utah Valley. Although a few of these sites are located within a few miles of Utah Lake, no frogs were observed in the area below the level subject to lake fluctuation. Although unsurveyed, potential spring-fed habitat occurs near Utah Lake. The spotted frog's affinity for cool, clear, spring-fed wetlands and the lack of recent sightings make it unlikely that the species occurs within the Jordan River, the highly turbid water of Utah Lake, or within the area subject to shoreline fluctuations.

2.3.3.6.4.2 Impacts. As identified above, the spotted frog's affinity for cool, clear, spring-fed wetlands and the lack of recent sightings make it unlikely that the species occurs within the highly turbid water of Utah Lake or within the area subject to shoreline fluctuations. However, even if the species is present, operation of the Bonneville Unit is not expected to negatively affect the species or its known or potential habitats.

2.3.3.6.5 Bald Eagle. The bald eagle (*Haliaeetus leucocephalus*) is listed as a threatened species by the FWS. Operation of the Bonneville Unit on Utah Lake would not likely have any effect on bald eagle breeding habitat because the species does not nest in the vicinity of the lake. The anticipated average annual increase in surface area during low water conditions and in volume of the lake would likely benefit wintering eagles by increasing habitat for fish, waterfowl, and other prey.

2.3.3.6.6 Peregrine Falcon. The peregrine falcon (*Falco peregrinus*) is listed as an endangered species by the FWS. Changes to Utah Lake resulting from operation of the Bonneville Unit would have no impact on breeding peregrine falcons because no nesting territories have been active in the region for several decades (Shields and Moretti 1982). The anticipated increase in the surface area and volume of the lake would likely benefit peregrines by increasing shoreline and wetland habitat for waterfowl, shorebirds, and other favored prey.

2.3.3.7 Cultural Resources

2.3.3.7.1 Utah Lake and Jordan River. Archaeological evidence has shown that Utah Lake was probably a well-used resource for fish and other lacustral animals (Baker and Janetski 1992, Janetski 1986, 1990), and the earliest historical sources indicate that Utah Lake continued to be important to the local Native Americans. The same historical use description is likely for the Jordan River. Shortly after the turn of the century, Native American fishing in Utah Lake became virtually nonexistent because of the increase in the numbers of Euro-American settlers and the decline in the numbers of fish.

A total of 69 recorded prehistoric sites within or near the affected environment were reviewed.

2.3.3.7.1.1 Impacts. Impacts to the cultural and paleontologic resources associated with Utah Lake resulting from the operation of the Bonneville Unit would be similar to the impacts of baseline conditions. However, conditions resulting from the Bonneville Unit would reduce the average annual water level fluctuations from about 2.8 to 2.5 feet. By reducing the magnitude of annual variability in lake elevation, the Bonneville Unit would protect some archaeological sites by keeping them underwater and reducing the exposure of others to wave and ice action.

2.3.3.7.2 Jordan River. Changes in discharge to the Jordan River would not affect cultural or paleontological resources.

2.3.3.8 Recreation

2.3.3.8.1 Utah Lake and Jordan River. Utah Lake is in the top 10 of Favorite Utah Waters. With about 95,000 surface acres, it is Utah's largest freshwater lake. In addition to being a popular sport fishery, Utah Lake is also attractive to boaters, water skiers, and jet skiers. The Jordan River provides what is considered good to excellent areas for passive urban recreation in terms of bird and nature watching and hiking. The following recreational resources exist in and around Utah Lake and along the Jordan River.

2.3.3.8.1.1 Utah Lake State Park. Utah Lake State Park is 5 miles west of Provo, just off Interstate 15. It provides access to Utah Lake for powerboats, sailboats, canoes, and kayaks. Facilities include a fishing jetty, boat launching ramps, a marina, seasonal/transient boat slips, restrooms, showers, handicapped-access fishing area, sewage disposal, fish cleaning stations, and an Olympic-sized ice skating rink open from December through March.

The facility was adversely affected by the 1983 floods and was officially closed from 1983 through 1987. The skating rink, opened in 1992, draw about 2,000 people a day to the park between December and March. The number of visitors to this park from 1985 through 1991 ranged from approximately 156,000 to 187,400. The number of visitors dramatically increased from approximately 216,000 in 1992, when the skating rink opened, to 657,000 in 1994.

2.3.3.8.1.2 Powell Slough State Waterfowl Management Area. The Powell Slough State Waterfowl Management Area is a large shoreline area located on the eastern shore of Utah Lake near the city of Orem. At present, the area comprises 638 acres, and negotiations are under way to add substantially to that amount. Although hunting is permitted, the area is undeveloped in terms of facilities.

2.3.3.8.1.3 Boat Ramps (Other than Utah Lake State Park). The City of American Fork operates American Fork Boat Harbor just south of the city. This facility has docks and ramps. Adjacent to it is a privately owned concession providing a trailer park and boat storage. A municipal boat ramp on the lakeshore at Vineyard was established to provide emergency access at the time of the 1983 floods.

2.3.3.8.1.4 Lincoln Beach. Lincoln Beach is an undeveloped county park at Lincoln Point on Utah Lake. Facilities include a boat ramp and a breakwater used for fishing. In 1981, Utah County officials recommended that the area around Lincoln Point be developed as an expanded marina. Such development is not currently

anticipated, although the same land is now zoned for recreational housing (Critical Environmental 2), which could be water-based.

2.3.3.8.1.5 East Bay Golf Course. The public East Bay Golf Course is located near the shoreline of Provo Bay just south of Provo. This facility has sold some of its land closest to Provo Bay and is now entirely located east of the freeway.

2.3.3.8.1.6 Lakeside Trail. Utah County Parks Department intends to develop a public trail around the entire perimeter of the lake. At the present time, the trail is in the planning stage, and the concept is shown on the Utah County Trails Master Plan.

2.3.3.8.2 Impacts. Impacts on Utah Lake recreational resources resulting from the operation of the Bonneville Unit would not be significant.

Based on the baseline and Bonneville Unit water levels for average conditions, operation of the Bonneville Unit would result in no change to the surface elevation of Utah Lake. Bonneville Unit operations would reduce the average annual water level fluctuation from about 2.8 feet to 2.5 feet. Drought periods would still occur, but would be less severe under Bonneville Unit conditions. The average surface area would be virtually the same as under baseline conditions; therefore, no impacts to recreational resources would occur. The 8 percent higher average annual salinity levels would also not result in any impacts to recreational resources since no change in game fish is predicted to occur.

It is anticipated that the increased average elevation would not have an adverse impact on recreational amenities or the operations at Utah Lake State Park. Personnel at Utah Lake State Park would welcome the increase in average elevation because it would reduce the need to adjust boat ramp elevations.

Operation of the Bonneville Unit would not prevent use of existing recreational facilities and would not make access to the current recreational resources more difficult. The Bonneville Unit would enhance current recreational uses such as fishing and boating by making them more accessible and enhance recreational uses by making the shoreline more attractive. It would not be expected to change the type of recreation experienced. In addition, the recreational opportunities on the Jordan River (sport fishing, bird watching, walking, nature watching) are primarily associated with the river and adjacent wetland habitats. Since the slightly modified flow regime is not expected to result in any significant adverse impacts to the river or adjacent wetlands, there are no adverse impacts predicted to occur to recreational opportunities along the river.

2.3.4 Cumulative Impacts of Bonneville Unit Historical Depletions on Colorado River Fish

A discussion of the indirect effects of the Bonneville Unit and SVP operations on critical habitat in the Duchesne River for the four Colorado River fish species through historical depletions from the Duchesne River is provided below. The effects of historical depletions on the Duchesne River and on critical habitat in the Green River were addressed in the 1990 Biological Opinion for the Strawberry Aqueduct and Collection System. This Biological Opinion identified the re-operation of Flaming Gorge Reservoir as the Reasonable and Prudent Alternative for the effects of the historical depletions.

Specifically, four fish species are sensitive to reductions in streamflows and could be affected by historic depletions to the Duchesne River. These species are the humpback chub (*Gila cypha*), originally listed as an endangered species on March 11, 1967; bonytail chub (*Gila elegans*), listed as an endangered species on April 23, 1980; Colorado squawfish (*Ptychocheilus lucius*), originally listed as endangered on March 11, 1967; and razorback sucker (*Xyrauchen texanus*), for which federal protection as an endangered fish became effective on November 23, 1991. In addition, critical habitat for these four species includes portions of the Green and Duchesne Rivers.

The Duchesne (tributary to the Green), Green (tributary to the Colorado), and Colorado Rivers are large rivers that are highly turbid, strong flowing, swift, and turbulent, yet historically subject to long periods of low flows during drought (Minckley 1973). Prior to achieving relatively stable flow conditions through damming, these rivers fluctuated quickly and radically and were inhabited by fish fauna that adapted to these vagaries. Impoundments on the major tributary streams of the upper Colorado River (Flaming Gorge Reservoir on the Green River and Starvation Reservoir on the Duchesne River) have resulted in cooler summer temperatures, warmer and more stable winter temperatures and flows, a reduction in turbidities, and stabilized chemical conditions.

These physical changes, plus competition from introduced exotic fish species, have caused a substantial decline in the native fish of these big rivers. As a result of this decline, Colorado squawfish, bonytail chub, humpback chub, and razorback sucker are federally listed as endangered. Presently, Colorado squawfish and razorback sucker are found in both the Duchesne and Green Rivers. In 1994, portions of the Green River, including the section below the confluence with the Duchesne River, were among the areas designated as "critical habitat" for the Colorado squawfish and razorback sucker, and the lower 2.5 miles of the Duchesne River was included in the critical habitat designation for the razorback sucker (FWS 1994a). The bonytail chub and humpback chub do not occur in the Duchesne River, but are still found in the Green River downstream of the confluence with the Duchesne River. The Desolation Canyon reach of the Green River is included in the critical habitat designation for these two species.

2.3.4.1 Timing of Depletions

The Bonneville Unit's Strawberry Aqueduct is currently in full operation and has diverted the full amount of allocated Bonneville Unit water to Strawberry Reservoir. This, together with the operation of other Bonneville Unit facilities in the Uinta Basin, amounts to an average annual depletion of 143,200 acre-feet from the Duchesne River. The SVP depletion averages 73,300 acre-feet per year, consisting of the transbasin diversion averaging 61,500 acre-feet per year and an assigned share of Strawberry Reservoir evaporation averaging 11,800 acre-feet per year. Most of the depletions occur during the spring runoff months of May and June. This period corresponds to spawning for Colorado squawfish, humpback chub, and bonytail chub, larval drift, and subsequent bottomland utilization for razorback sucker. During the late summer period (July, August, and September), when the young-of-the-year of the above species occupy low velocity habitats, less water is diverted from the Duchesne River system. Currently, Strawberry Reservoir is nearing full capacity. When that point is reached, expected in the spring of 1998, diversion by the Strawberry Aqueduct will be curtailed until Bonneville Unit water can be used in the Bonneville Basin.

2.3.4.2 Potential Effects of Historical Depletions

The historical depletions for the Bonneville Unit and the SVP could have several potential impacts on the four Colorado River fish. Within the area of the Duchesne River designated as critical habitat, the reduction in flows may cause reduction in useable habitat. During the spring, Colorado squawfish and razorback sucker appear to use the Duchesne River, perhaps for temporary residency as these fish prepare to spawn elsewhere in the Colorado River system. An abundance of cobble substrate in areas where adult razorback sucker and Colorado squawfish were collected during 1993 may indicate that potential spawning habitat is also available in the Duchesne River (Lentsch and Cranney 1994). Downstream of the Duchesne River, other potential impacts could include alteration of timing of spawning, reduction in bottomland flooding, and alterations to young-of-the-year habitat. Potential impacts to critical habitat on the Green River have been addressed for the Bonneville Unit depletion. A Biological Opinion addressing critical habitat on the Duchesne River has been drafted, but is presently undergoing internal agency review.

2.3.4.3 Summary of Effects

The average annual depletion of 143,200 acre-feet for the Bonneville Unit and 73,300 acre-feet for the SVP from the Duchesne River may adversely modify critical habitat within the Duchesne River. The average annual

depletion of 61,500 acre-feet for the Strawberry Valley Project also may adversely affect the humpback chub, razorback sucker, Colorado squawfish, and bonytail chub and may adversely modify critical habitat within the Green River. The Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (FWS 1994c) provides the Reasonable and Prudent Alternative to avoid the likelihood of jeopardy to the existence of the four Colorado River endangered fish, including the humpback chub, resulting from all existing past impacts related to historical projects, such as the Bonneville Unit depletions to Strawberry Reservoir and the SVP.

Chapter 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

The purpose of this chapter is to 1) identify baseline environmental resources (the affected environment) that would be affected by construction, operation, and maintenance of the Spanish Fork Canyon-Nephi Irrigation System (SFN System) and the locally-funded distribution and on-farm systems as described in Chapters 1 and 2) discuss potential environmental consequences (impacts) associated with construction, operation, and maintenance activities associated with a) the SFN System Proposed Action and alternatives including the completion of the Diamond Fork System, b) acquisition of the Utah Lake water rights, c) implementing the legislatively mandated CUPCA minimum flows, d) local development, and e) necessary operating agreements for Strawberry Reservoir and Utah Lake.

This chapter is organized by resource topic. Each resource topic identifies the affected environment and potential environmental consequences for the Proposed Action (also known as the Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative") and the five action alternatives (the Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative" and Without SVP Water Conveyance [MCAPW-DFT] Alternative, Main Conveyance Aqueduct with Monks Hollow Dam [MCAP] Alternative, Main Conveyance Aqueduct with Monks Hollow Dam and Without SVP Water Conveyance [MCAPW] Alternative, Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam [MCATC] Alternative, Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam and Without SVP Water Conveyance [MCAT] Alternative). The impacts of the No Action Alternative are also presented in this section, particularly with regard to the impacts of additional deliveries for irrigation. The total impact of the No Action Alternative on Utah Lake is presented in Chapter 2. All environmental impacts identified are discussed at a level commensurate with the severity of the impact; significant impacts are discussed in detail, and insignificant impacts are summarized. The impact analysis takes into account that the standard operating procedures identified in Appendix B, *Standard Operating Procedures*, would be implemented during construction and operation activities.

Impacts that would result from the construction and operation of the Diamond Fork System were addressed in the *Diamond Fork Power System Final EIS* (USBR 1984) and the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). To facilitate a comparison of impacts associated with the "Diamond Fork Tunnel Alternative" aspect of the SFN System Proposed Action and MCAPW-DFT Alternative, certain impacts associated with the Diamond Fork System have been incorporated into this document. The Diamond Fork System components addressed depend upon the SFN System alternative being analyzed. Accordingly, discussion of the MCAP, MCAPW, MCATC, and MCAT Alternatives includes Monks Hollow Dam and Reservoir, and the No Action Alternative incorporates Three Forks Dam and Reservoir and the Diamond Fork Pipeline Extension. In some cases, information from the *Diamond Fork Power System Final EIS* (USBR 1984) and *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) was revised and/or supplemented with additional information.

In preparing the impact analyses, consideration was given to the issues and concerns raised by the public and agencies during the scoping process (see Chapter 4 for a discussion of the SFN System scoping process). Other issues that were raised during the SFN System planning process, but outside of the scoping process (e.g., during agency review of the SFN System environmental study work plans and preliminary versions of this Draft Environmental Impact Statement [DEIS]) have also been considered in the analysis. These issues are identified, where applicable, in the individual resource sections.

Introduction

To support the impact analysis presented in this chapter, seven detailed technical reports were prepared, as listed below:

- *Aquatic Resources Technical Report* (CUWCD 1998a)
- *Hydrology and Water Resources Technical Report* (CUWCD 1998b)
- *Special-Status Species Technical Report* (CUWCD 1998c)
- *Wetland Resources Technical Report* (CUWCD 1998d)
- *Wildlife Resources Technical Report* (CUWCD 1998e)
- *Utah Lake Hydrology Technical Report* (CUWCD 1998f)
- *Environmental Contaminants Technical Report* (CUWCD 1997a)

Each report provides in-depth technical data on the affected environment, analytical procedures used to determine impacts, and impacts to the specific resource. The contents of the reports are summarized for inclusion in this chapter. The technical reports are not meant to be "stand-alone" documents; they rely on the project description information provided in Chapter 1 of this DEIS.

As identified in Chapter 1, environmental impacts associated with the Central Utah Project Completion Act's (CUPCA) mandated minimum flows requirement in Diamond Fork Creek are addressed in this DEIS. The mandated minimum streamflows have been incorporated into the Proposed Action and each of the alternatives. Also discussed in Chapter 1 is the relationship between the SFN System and related actions (local development). Although the Central Utah Water Conservancy District (CUWCD) would not be responsible for the development, construction, and operation of the irrigation distribution systems, on-farm systems, and municipal and industrial (M&I) water systems that would be necessary to deliver water from SFN System facilities, the affected environment and potential environmental impacts associated with these systems are included in this chapter for reasons discussed in Section 1.9.1.

Bonneville Unit water would be delivered to Utah Lake under the Proposed Action and all of the alternatives. The water provided would compensate for reduced inflow from the Provo River and, under the Proposed Action and the MCAPW-DFT and No Action Alternatives, from reduced inflow from the southern Utah Valley groundwater aquifer that would occur as a result of groundwater pumping for M&I use. The cumulative impacts of the entire Bonneville Unit on Utah Lake and the Jordan River were analyzed and described in Chapter 2. That analysis showed that the entire Bonneville Unit would have no significant effect on the environmental resources in, and adjacent to, Utah Lake and downstream along the Jordan River. A major reason for this is that the operation of the Bonneville Unit, including the SFN System, has been planned so as to avoid hydrologic changes to Utah Lake and the Jordan River. Also, no SFN System facilities or related actions would be constructed in, or along, the shoreline of Utah Lake. For these reasons, Utah Lake and the Jordan River are not included in the affected areas of the Proposed Action and its alternatives in the analyses presented in this chapter.

3.2 Water Resources

3.2.1 Introduction

The information and analysis provided in this section was summarized from the *Hydrology and Water Resources Technical Report* (CUWCD 1998b). This section discusses the impact of the SFN System and related local distribution and on-farm system modifications on water resources in terms of surface and groundwater quantity. The water quantity impact analysis presented in this section also provides the basis for the evaluation of impacts related to aquatic resources, threatened and endangered species, wetland resources, water quality, recreation, wildlife, and agriculture.

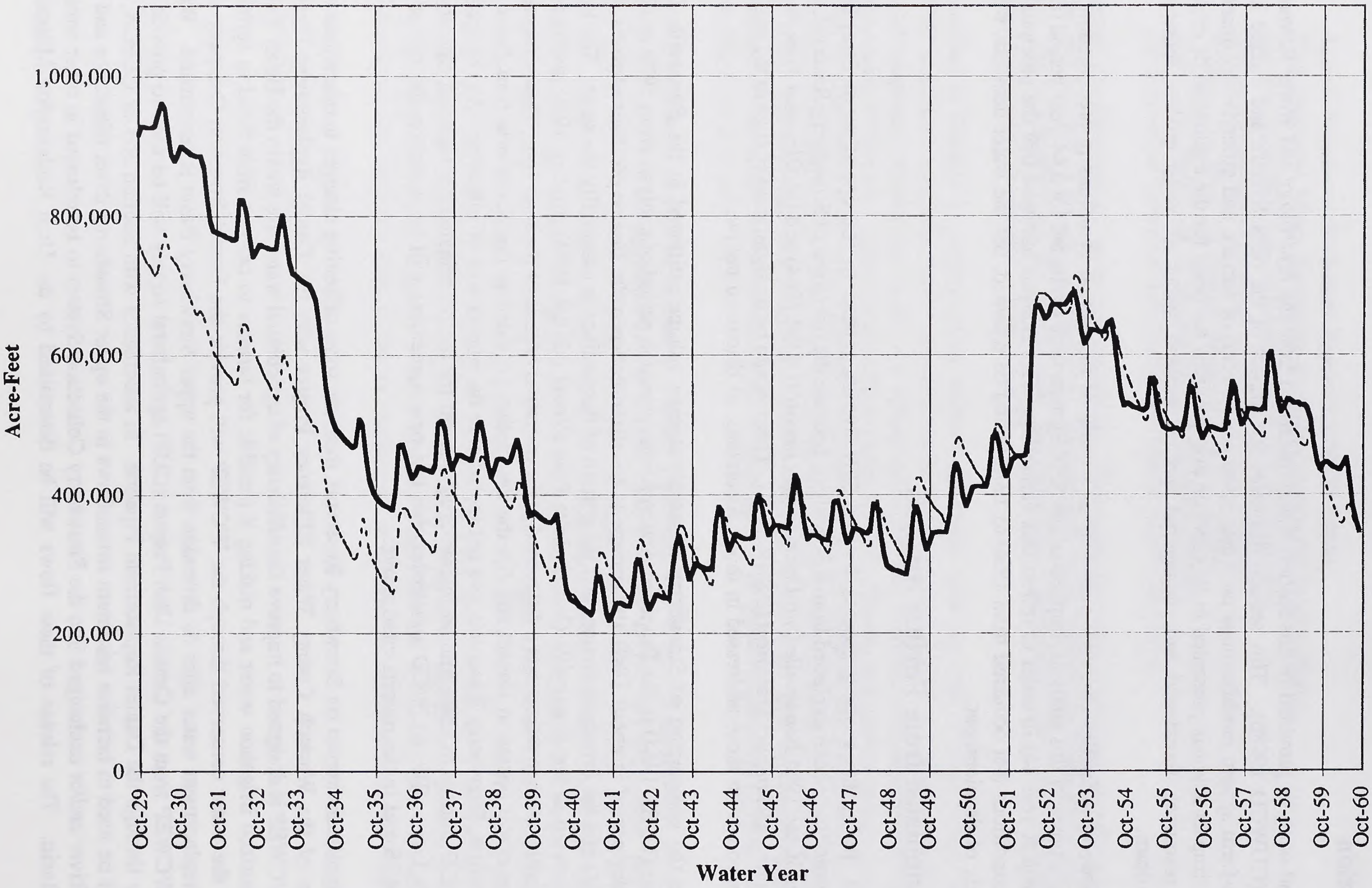
Surface and groundwater quantities can vary over time as a result of the natural variations in precipitation and water supply. For purposes of this analysis, impacts of the SFN System were evaluated for a 44-year period (from project year 1 to project year 44) in order to reflect this variability. This analysis assumed that the precipitation and water supply conditions that occurred from 1930 to 1973 would be repeated, but the water demands would reflect present levels of development.

3.2.2 Issues Eliminated from Further Analysis

Some issues raised during the scoping process for the SFN System related to the operation of Strawberry Reservoir. These issues have been excluded from this analysis because the operation of Strawberry Reservoir was previously described in the 1964 *Bonneville Unit Definite Plan Report* (USBR 1964) and the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984). There would be no significant change in the impacts to Strawberry Reservoir from those addressed in those documents, as discussed below.

Figure 3.2-1 shows the comparison of Strawberry Reservoir storage volume estimated in the *Bonneville Unit Definite Plan Report* (USBR 1964) to the Proposed Action for the common period of analysis from 1929 to 1960. At the end of the dry period in about 1940, the storage is equalized between the *Bonneville Unit Definite Plan Report* (USBR 1964) and the Proposed Action, and the pattern of fluctuations is essentially the same. The lower storage volume estimated in the *Bonneville Unit Definite Plan Report* (USBR 1964) prior to 1940 results from a smaller assumed initial storage rather than a difference in the operation criteria of the reservoir. This comparison indicates that the reservoir operation impact still fits the description provided in the *Bonneville Unit Final EIS* (USBR 1973); therefore, Strawberry Reservoir was not included in the impact area of influence. As required by CUPCA, the CUWCD intends to enter into an operating agreement for the coordinated operation of Strawberry Reservoir and Utah Lake. The CUWCD anticipates that this new agreement will be based on the operations described in this DEIS and in the reports cited above.

While there is no significant impact on Strawberry Reservoir, there are some offsetting changes in operations with the implementation of the Wasatch County Water Efficiency Project with the Daniel Replacement Pipeline (WCWEP). The WCWEP is designed to improve the efficiency of agricultural water use within the Heber Valley by delivering pressurized irrigation water and making it possible for farmers to convert from flood to sprinkler irrigation. Part of the water conserved through the WCWEP will provide the Daniel Irrigation Company with 2,900 acre-feet of replacement water after its diversion from the upper Strawberry Basin is terminated. Water conserved by the WCWEP from the Central Utah Project (CUP) agricultural supply will be used to provide the replacement supply through the Daniel Replacement Pipeline. In accordance with Section 303 of CUPCA, the 2,900 acre-feet will be used to increase minimum streamflows in the upper Strawberry River tributaries and the lower Strawberry River and/or exchanged into the Strawberry Collection System to be released in other streams within the Uinta Basin. The release of these flows will be determined by the Utah Reclamation Mitigation



Note: Proposed Action - Storage based on results of the Strawberry Reservoir Operations Model.

Figure 3.2-1
Strawberry Reservoir Storage Volume

and Conservation Commission (Mitigation Commission) in consultation with the U.S. Fish and Wildlife Service (FWS) and the Utah Division of Wildlife Resources. The operation of Strawberry Reservoir will include the release/exchange of the 2,900 acre-feet of increased flows. Because the 2,900 acre-feet will flow into and then be released from the reservoir or exchanged for releases along the Strawberry Aqueduct, the net inflow will be unchanged and the effect on the contents of Strawberry Reservoir will be negligible.

3.2.3 Issues Addressed in the Impact Analysis

Issues identified in the scoping process include the following:

- Impacts on Mona Reservoir and Utah Lake levels
- Impacts on flows in creeks and rivers
- Patterns of irrigation return flows
- Impacts of recharge and irrigation return flows on groundwater levels

Surface water quantities for rivers and creeks are addressed by quantifying the monthly flows for the analysis period. Reservoir and lake quantities are assessed by evaluating the volume of water in storage for each month of the analysis period and the associated water level elevation and lake/reservoir surface area.

Groundwater quantities are addressed by quantifying the change in groundwater storage and the associated change in water levels. The changes in outflow from groundwater to springs are also assessed to help evaluate changes in surface water flows for features that receive these flows.

3.2.4 Description of Impact Area of Influence

The impact area of influence for water quantity covers those portions of southern Utah County and eastern Juab County to which water would be conveyed and delivered by the SFN System. The relationship of the SFN System to the major water features in the impact area of influence is presented in Figure 3.2-2. For clarity of presentation, Figure 3.2-3 shows additional detail for major water features in the Diamond Fork Creek drainage.

Operation of the SFN System would affect flows in Sixth Water Creek, Diamond Fork Creek, the upper Spanish Fork River (below its confluence with Diamond Fork Creek and above the Strawberry Diversion Dam), and the lower Spanish Fork River (below the Strawberry Diversion Dam and above Utah Lake) as a result of changes in releases from Strawberry Reservoir and changes in the amounts and locations of diversions.

Mona Reservoir would be used to store SFN System water (both direct deliveries from the SFN System Main Conveyance Aqueduct and project irrigation return flows). Additional inflow to Utah Lake would be derived from increased irrigation return flows, increased outflow from springs, and delivery of CUP water via Diamond Fork Creek and the Spanish Fork River.

Flows in Currant Creek below Mona Reservoir (referred to as "lower Currant Creek" in this report) would reflect the conveyance of CUP water in the creek for irrigation use in the Elberta area and the delivery of water to Utah Lake.

Flows in Salt Creek (i.e., below the Salt Creek diversions) will change as a result of the operation of the Salt Creek facilities and the East Juab Water Efficiency Project (EJWEP), a project to be built independently of the SFN System. Operation of these facilities will be coordinated with SFN System operations, and discussion of the Salt Creek impacts is included in this section.

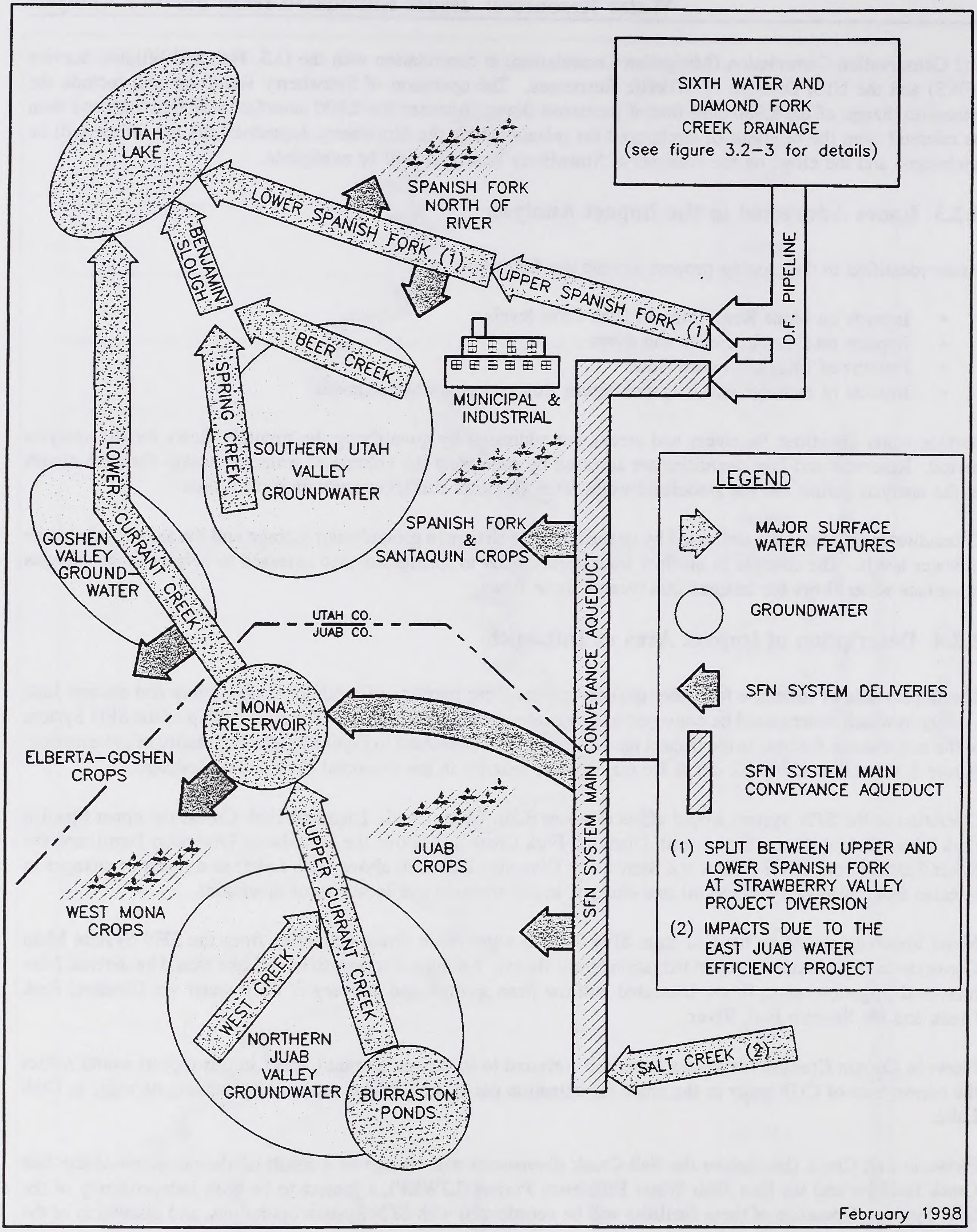


Figure 3.2-2
Relationship of SFN System to the Major Hydrologic Features
in the Impact Area of Influence

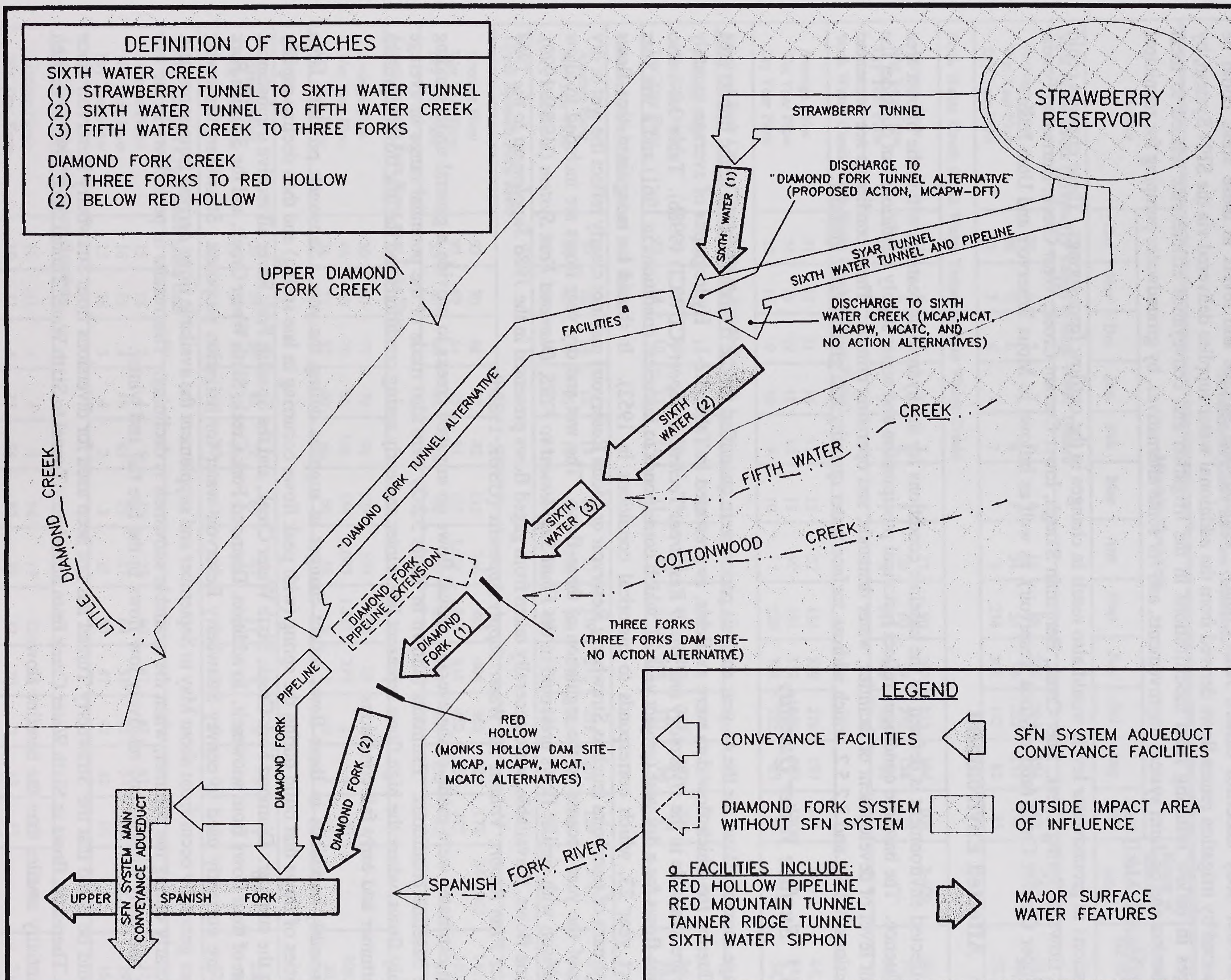


Figure 3.2–3
Major Hydrologic Features in the Diamond Fork Drainage

Two groundwater bodies underlie Goshen Valley and southern Utah Valley in southern Utah County. Another groundwater body underlies eastern Juab County. Groundwater storage and levels in these areas could be influenced by irrigation return flows derived from the additional water supplies delivered via the SFN System, by changes in inflow resulting from modifications in the irrigation and conveyance efficiencies related to local distribution and on-farm system improvements, and for some alternatives, by groundwater pumping for municipal and industrial (M&I) use.

Alterations in groundwater levels would also result in changes in the outflow from springs. These changes could affect flows in Spring Creek, Beer Creek, Benjamin Slough, lower Currant Creek, West Creek, Burraston Ponds, and upper Currant Creek (above Mona Reservoir), as well as inflows to Mona Reservoir and Utah Lake.

3.2.5 Affected Environment

The affected environment is defined by the baseline conditions for the hydrologic features within the impact area of influence. The baseline conditions reflect historical precipitation and water supply conditions but consider the present level of development of facilities, water demands, and operating criteria. These conditions are presented in Sections 3.2.5.1 and 3.2.5.2, which address surface water quantity and groundwater quantity.

3.2.5.1 Surface Water Quantity

Average monthly flows for the 44-year analysis period were quantified for the rivers and creeks in the impact area of influence for which flow data were available, as presented in Table 3.2-1. Hydrographs of average monthly flows are available in the *Hydrology and Water Resources Technical Report* (CUWCD 1998b). Table 3.2-1 also presents flows for a dry year (project year 32, which corresponds to historical conditions in 1961) and a wet year (project year 23, which corresponds to historical conditions in 1952). It should be recognized that flows downstream of reservoirs (such as Strawberry Reservoir or Mona Reservoir) may not clearly reflect the wet or dry nature of the year because of the regulation of these flows. The wet and dry year flows are included to allow comparison with similar flows presented in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). Baseline flows, if available, were generally taken from gaged flows presented in the *1988 Supplement to the 1964 Definite Plan Report, Volume III, Water Supply Appendix* (USBR 1988d).

Rough estimates were made of the average annual flows on ungaged creeks to provide a general understanding of the baseline conditions. Estimates (shown in Table 3.2-2) were also made of the potential range in average monthly flows, where the high flows represent late winter and early spring conditions and the low flows represent late summer and early fall conditions.

The monthly variations in these flows reflect changes in supplies during the year. Snowmelt provides large quantities of flows that build during the spring (with peak flows occurring in late spring) and then decline rapidly during the summer. Diamond Fork Creek, Sixth Water Creek, and the Spanish Fork River all receive a substantial portion of their flows from snowmelt. In addition, Diamond Fork Creek, Sixth Water Creek, and the Spanish Fork River are currently used to convey Strawberry Reservoir water for irrigation purposes. Strawberry Reservoir releases generally occur from about May to September and supplement the available flows derived from snowmelt, particularly during the summer, when the available snowmelt is declining. This results in peak flows in the late spring and early summer and relatively low flows in the late fall and winter.

It should be noted that the Strawberry Tunnel has not been used for diversions from Strawberry Reservoir since 1995. Therefore, flows in Sixth Water Creek from Strawberry Tunnel to Sixth Water Tunnel since 1995 have been substantially smaller than the baseline flows.

Table 3.2-1
Streamflows Under Baseline Conditions*

Page 1 of 2

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Sixth Water Creek (Strawberry Tunnel to Sixth Water Tunnel)														
Average Flow	27	8	7	7	7	8	16	88	226	274	194	108	2-409	58,811
Wet Year Flow	30	8	8	7	8	8	34	55	96	232	157	175		49,567
Dry Year Flow	12	7	6	7	7	7	3	214	308	182	81	35		52,703
Sixth Water Creek (Sixth Water Tunnel to Fifth Water Creek)														
Average Flow	27	8	7	7	7	8	17	90	227	275	194	108	2-409	59,253
Wet Year Flow	30	9	8	7	8	8	39	63	99	232	158	175		50,725
Dry Year Flow	12	7	7	7	7	7	3	214	308	182	82	36		52,866
Sixth Water Creek (Fifth Water Creek to Three Forks)														
Average Flow	31	12	11	10	11	13	32	116	239	279	197	111	5-410	64,345
Wet Year Flow	34	13	12	11	12	13	92	151	132	240	163	180		64,037
Dry Year Flow	15	11	9	10	9	10	7	220	308	182	83	38		54,744
Diamond Fork Creek (Three Forks to Red Hollow)														
Average Flow	39	16	14	12	14	18	67	179	271	293	207	120	3-421	75,883
Wet Year Flow	44	20	16	15	16	18	218	363	213	263	197	205		96,300
Dry Year Flow	23	13	10	13	11	11	17	236	308	181	96	47		58,500
Diamond Fork Creek (Below Red Hollow)														
Average Flow	39	16	14	12	14	18	67	179	271	293	207	120	3-421	75,883
Wet Year Flow	44	20	16	15	16	18	218	363	213	263	197	205		96,300
Dry Year Flow	23	13	10	13	11	11	17	236	308	181	96	47		58,500
Upper Spanish Fork River														
Average Flow	93	70	68	67	82	113	246	463	404	363	282	178	34-1,863	147,078
Wet Year Flow	97	67	64	75	81	107	1,054	1,863	616	452	336	312		310,636
Dry Year Flow	55	48	40	45	50	58	57	274	327	203	133	82		83,048
Lower Spanish Fork River near Lake Shore														
Average Flow	30	67	77	79	98	129	199	138	22	3	3	8	0-1,517	51,364
Wet Year Flow	46	68	70	85	102	144	1,088	1,517	279	2	4	40		208,526
Dry Year Flow	21	51	57	60	64	66	16	5	1	0	2	1		20,601
Beer Creek														
Average Flow	29	34	39	48	72	69	43	17	8	4	4	9	0-244	22,595
Wet Year Flow	29	34	37	54	78	72	244	54	13	5	5	12		38,100
Dry Year Flow	10	22	26	34	37	41	29	2	2	0	0	0		12,100
Lower Currant Creek Below Mona Dam														
Average Flows	15	18	3	4	6	13	23	60	47	42	31	25	1-83	17,458
Wet Year Flow	16	19	4	18	83	79	47	64	51	45	34	28		29,443
Dry Year Flow	15	18	3	4	2	2	21	59	47	42	32	26		16,403
Lower Currant Creek Below diversions														
Average Flows	10	11	4	4	7	14	15	32	26	23	18	15	3-84	10,859
Wet Year Flow	10	11	4	18	84	80	37	32	26	23	18	15		21,495
Dry Year Flow	10	11	4	4	3	3	12	32	26	23	18	15		9,748

Table 3.2-1
Streamflows Under Baseline Conditions*

Page 2 of 2

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Salt Creek														
Average Flows	10	12	10	10	11	14	48	74	52	22	15	11	3-250	17,432
Wet Year Flow	9	8	8	8	10	13	156	250	118	63	46	30		43,648
Dry Year Flow	6	8	8	8	7	7	6	15	12	6	6	6		5,737
Upper Currant Creek														
Average Flows	11	13	14	13	20	27	27	29	17	7	6	7	4-93	11,481
Wet Year Flow	12	15	15	15	22	90	92	93	81	7	6	8		27,491
Dry Year Flow	9	11	12	12	17	22	22	24	13	6	5	6		9,614

*Note: Average for 44-year period of analysis.

Table 3.2-2
Potential Ranges in Average Monthly Flows in Ungaged Rivers and Creeks in Impact Area of Influence

Creek	Average Annual Flows (acre-feet)	Range of Average Monthly Flows (cubic feet per second)
Spring Creek	8,000	1 to 25
Benjamin Slough	47,000	5 to 150
West Creek	1,500	0 to 7
Burraston Ponds	1,000	1 to 3

Flows on the lower Spanish Fork River are complicated because of the numerous diversions. The flows for the lower Spanish Fork River near Lake Shore shown in Table 3.2-1 are based on gaging station records. The discussion below on the five major diversions on the Spanish Fork River (Strawberry, East Bench, Mill Race, Lake Shore, and Huff Dam) is intended to provide a general understanding of the lower Spanish Fork River between the Castilla and Lake Shore gages (see Figure 3.2-4) and is based on discussions with the Spanish Fork River Commissioner, John Mendenhall (Barnes 1994).

The first diversion location is the Strawberry Diversion Dam, which diverts water to the Power Canal. In the winter, all of the flow is diverted for power generation, except for about 5 cubic feet per second (cfs) that leaks past the diversion dam. In the summer, 20 to 50 cfs are released from the diversion dam to supply the East Bench Canal. The Power Canal delivers water to the High Line, Salem, and South Field Canals (which deliver water south of the Spanish Fork River) and to the Mapleton Lateral (which crosses and delivers water north of the river). Also, some water, including the supply for the Mill Race and Lake Shore Canals, is released from the Power Canal to the Spanish Fork River.

The second diversion is for the East Bench Canal, which conveys water to lands north of the Spanish Fork River. Essentially all available flows are diverted to the East Bench Canal during the summer. About 300 yards below the dam, the river receives approximately 5 cfs of spring flows.

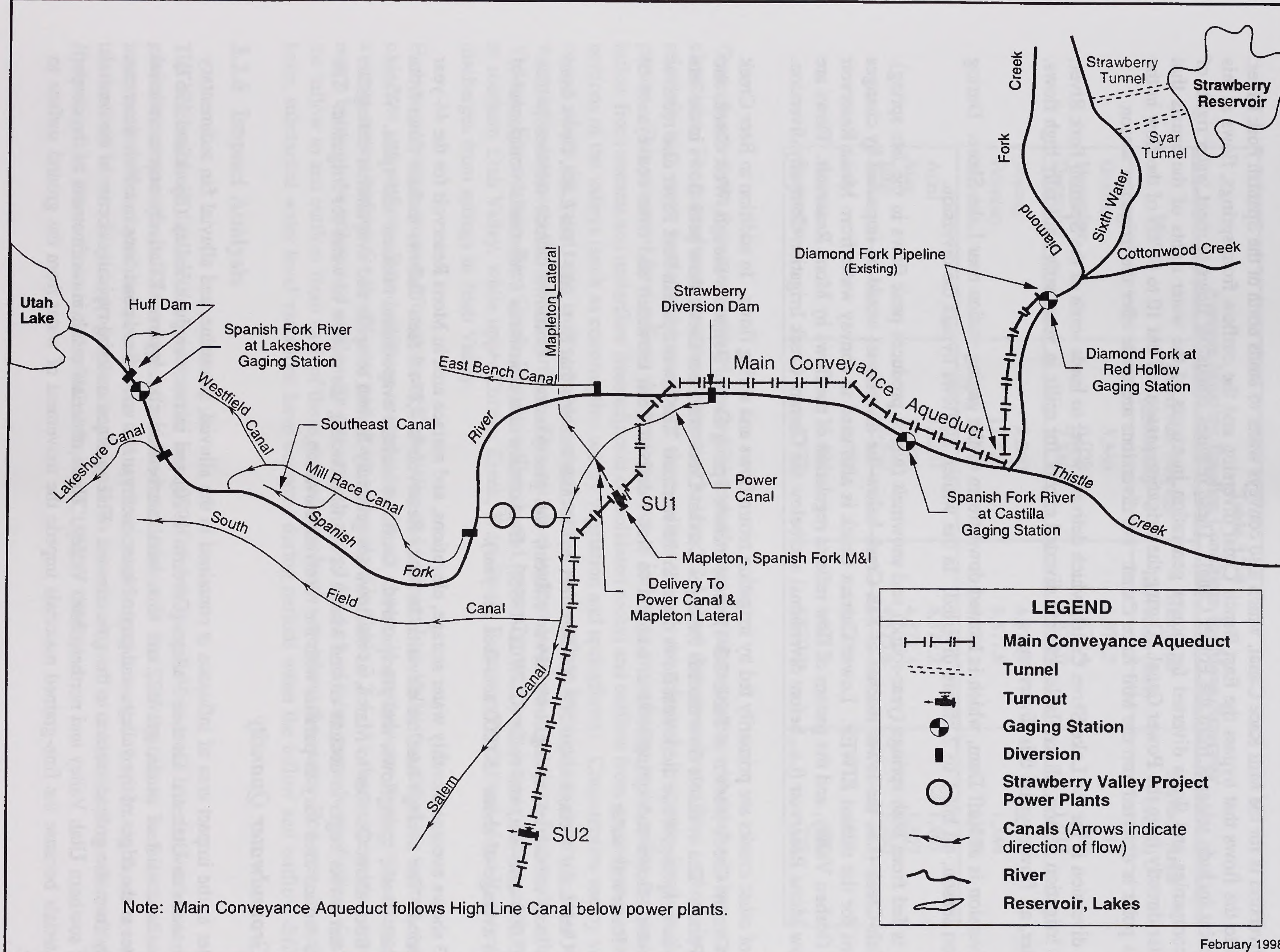


Figure 3.2-4
Schematic Representation Showing Diversions Along Spanish Fork River and Main Conveyance Aqueduct

The third diversion is for the Mill Race Canal, which also conveys water to lands north of the Spanish Fork River. In addition to the flows that bypass the East Bench Canal diversion and the outflow from springs, flows at this diversion point include releases from the Power Canal. These releases consist of flows to meet water rights of the canal companies and flows diverted for power generation in excess of the water rights of the canals that receive water directly from the Power Canal. During the irrigation season, all but 10 to 40 cfs of the flow in the river at this point is diverted into the Mill Race Canal. No diversions are made after the irrigation season.

The fourth diversion is for the Lake Shore Canal, which delivers water to lands south of the Spanish Fork River. During the irrigation season, all available water is diverted except for spills in years with unusually high flows. In the winter, all flows bypass this diversion.

The last diversion is at Huff Dam, which is located downstream of the gaging station near Lake Shore. During the irrigation season, all but 1 to 2 cfs are diverted. In the winter, all flows bypass the diversion.

Salt Creek is fed from both springs (year-round) and snowmelt (which produces peak flows in the late spring). Flows in Salt Creek (i.e., the lower reaches of Salt Creek below the diversions) would be impacted by changes in diversions for the related EJWEP. Lower Currant Creek is also used to convey water from Mona Reservoir to lands in Goshen Valley, and the pattern of flow reflects regulation of the flows by Mona Reservoir. Flows are shown below Mona Reservoir (i.e., before diversions) and below the Currant Creek Irrigation Company diversion.

A number of other creeks are primarily fed by irrigation return flows and spring flows. In addition to Beer Creek and upper Currant Creek (shown in Table 3.2-1), these include Spring Creek, Benjamin Slough, West Creek, and Burraston Ponds. The available flow records for upper Currant Creek and Beer Creek show peak flows in the late winter and early spring, while the lowest flows occur in the summer. The lower Spanish Fork River also receives irrigation return flows and springflows in addition to flows derived from snowmelt and from conveyance of Strawberry Reservoir water.

Inflows to Utah Lake average about 568,000 acre-feet and include streams that flow into Utah Lake, flows from drains and local tributaries, springflows, sewer effluent, and precipitation. Outflows include releases (which average 223,000 acre-feet) and spills (CUWCD 1998f). Evaporation also constitutes a substantial component of outflow (an average of about 330,000 acre-feet per year).

Table 3.2-3 shows average monthly water storage, elevations, and surface area in Mona Reservoir for the 44-year baseline period. The average baseline elevation in Mona Reservoir is 4,874.8 feet. Inflows include flows from upper Currant Creek, springflows, and precipitation. Outflows include evaporation, releases, and spills. Water levels rise from about October to March, as outflows are generally limited to spills and evaporation during this period. Water levels begin to decline around March or April, reflecting the release of water for irrigation. The storage and surface area vary in parallel with the reservoir elevation.

3.2.5.2 Groundwater Quantity

Groundwater in the impact area of influence is contained in the alluvial, lacustrine, and alluvial fan sedimentary deposits in southern Utah and Goshen Valleys (Cordova 1970) and in northern Juab Valley (Bjorkland 1967). These deposits consist of sands, gravels, and silts, with interbedded clay layers. Relatively coarse material predominates at the edges of the valleys, and groundwater occurs under unconfined conditions in which water can travel freely from the ground surface to the groundwater. Finer-grained material typically occurs in the central portions of southern Utah Valley and northern Juab Valley. These materials result in confinement of the deeper aquifer materials because the fine-grained materials impede the movement of water from the ground surface to the aquifer.

Table 3.2-3
Average Monthly Baseline Conditions for Mona Reservoir

Month	Reservoir Storage (acre-feet)	Reservoir Elevation (feet)	Surface Area (acres)
October	5,386	4,871.5	819
November	6,028	4,872.4	892
December	7,340	4,874.0	1,017
January	9,260	4,875.9	1,175
February	11,558	4,877.8	1,344
March	13,220	4,879.1	1,457
April	13,291	4,879.2	1,461
May	10,935	4,877.4	1,307
June	8,822	4,875.6	1,155
July	6,727	4,873.3	963
August	5,404	4,871.3	806
September	4,772	4,870.2	728

Groundwater flows from areas with relatively high groundwater elevations to areas with relatively low groundwater elevations. The groundwater elevations presented in Map 3.2-1 show that groundwater flow is generally from the relatively high water levels at the margins of these valleys towards the relatively low water levels in the central portion. This pattern of flow reflects the predominance of inflow to groundwater at the valley margins (such as inflow from streams and underflow from adjacent consolidated rocks) and outflow from groundwater in the central portions of the valleys (such as consumptive use by vegetation and springflows). Consumptive use by vegetation occurs where the water table is close to the ground surface, and outflow from springs occurs in areas where the water table intersects the ground surface. This occurs at various locations in southern Utah and northern Juab Valleys. For example, Beer Creek, Benjamin Slough, and lower Currant Creek receive discharges from springs in southern Utah Valley, while upper Currant Creek, West Creek, Burraston Ponds, and Mona Reservoir receive discharges from springs in Juab Valley.

Hydrologic budgets prepared for southern Utah Valley and northern Juab Valley quantified the various components of inflow and outflow. Based on these components, the net change in groundwater storage was estimated. The average annual budgets for the 44-year period are summarized in Table 3.2-4. As shown, there is an approximate match between the inflow and outflow for the analysis period for each of these groundwater bodies. On average, the inflow to and outflow from each of these groundwater bodies are about the same. However, on a short-term basis, substantial water level variations have occurred during periods when the inflow and outflow differ.

3.2.6 Impact Analysis

The discussion in this section presents the impacts of the Proposed Action and alternatives on surface and groundwater quantities. These impacts include consideration of the SFN System as well as local actions to improve the efficiency of the conveyance and application of irrigation water. Impacts on flows are shown in tabular form herein. Flow hydrographs comparing flows for each alternative to baseline flows are available in the *Hydrology and Water Resources Technical Report* (CUWCD 1998b).

Table 3.2-4
Groundwater Budget Under Baseline Conditions for Southern Utah Valley and Northern Juab Valley

Component of Groundwater Budget	Southern Utah Valley Average Annual Volume (acre-feet)	Northern Juab Valley Average Annual Volume (acre-feet)
Inflow		
Irrigation return flows	59,900	13,500
Underflow, inflow from creeks	72,400	30,300
Percolation of precipitation	15,900	5,900
Total Inflow	**148,200**	**49,700**
Outflow		
Outflow from springs	71,200	19,800
Phreatophyte consumptive use	55,000	15,100
Groundwater extractions from wells	16,700	15,000
Subsurface outflow	4,000	500
Total Outflow	**146,900**	**50,400**
Average Annual Change in Storage	**1,300**	**(700)**

3.2.6.1 Significance Criteria

Groundwater level impacts are considered significant if they impair the ability to obtain groundwater from existing wells. Such impairment would adversely impact holders of groundwater rights.

Existing surface water rights were protected in the formulation of the SFN System. Consequently, significance criteria for surface water flows were not formulated. However, surface waters support various other environmental resources in the project area. Thus, streamflow rates and other flow parameters affecting those resources were considered where applicable in the development of significance criteria for those resources, which are described in other sections of Chapter 3.

3.2.6.2 Potential Impacts Eliminated from Further Analysis

Utah Lake and the Jordan River has been excluded from this analysis, as noted in Section 3.1. The water delivered to Utah Lake under the Proposed Action and its alternatives would be for exchanges to compensate for certain reductions in inflow to the lake. Thus, the operation of the Proposed Action and its alternatives would not significantly change the level of the lake or flows in the Jordan River.

3.2.6.3 Proposed Action

This section describes the construction and operation impacts to surface and groundwater quantities resulting from the Proposed Action. These impacts are summarized in Section 3.2.6.10.

3.2.6.3.1 Construction Impacts. Potential construction impacts on surface and groundwater quantities would occur through the use of water for construction activities. The total amount of water required for construction purposes would be less than 1,000 acre-feet. The contractor would obtain water required during construction from approved sources. Use of wells to obtain groundwater would be by agreement with well owners. Based on the limited amount of construction water required and the need to acquire water rights for this supply, the potential construction impact on water quantities would not be measurable.

Map 3.2-1
Wells and Groundwater Contours in Northern Juab and Southern Utah Valleys

3.2.6.3.2 Operation Impacts. Operation impacts would result from the operation of the SFN System to convey and deliver water for irrigation and M&I use. These impacts would also include the effects of improvements in distribution facilities and on-farm systems that would occur as a consequence of the SFN System. These impacts on surface water quantities and groundwater quantities are addressed in the sections that follow.

*3.2.6.3.2.1 **Surface Water Quantity.*** Monthly changes in average flows were quantified for surface water features that have quantified monthly baseline flows, as shown in Table 3.2-5. Monthly flows are also shown for a wet and dry year. For those features without quantified monthly baseline flows (Spring Creek, Benjamin Slough, West Creek, and Burraston Ponds), the percentage change in flows was assessed based on the percentage change in outflow from springs that feed these features.

The changes from baseline flow in Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River would result, in part, from the maintenance of minimum flows in Sixth Water Creek and Diamond Fork Creek (as mandated by CUPCA), the conveyance of water to Utah Lake, the conveyance of some SFN System water in these streams, and the conveyance of some of the existing flows in the Diamond Fork Pipeline, "Diamond Fork Tunnel Alternative" facilities, and the SFN System Main Conveyance Aqueduct. During the winter, flows would increase relative to baseline conditions because of the CUPCA-mandated minimum flows and water delivery to Utah Lake. Peak flows in the late spring and early summer in Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River would be less than under baseline conditions because much of the irrigation water would be conveyed in the "Diamond Fork Tunnel Alternative" facilities, Diamond Fork Pipeline, and the SFN System Main Conveyance Aqueduct. The average annual flow in these features would be decreased from baseline.

Flow in the lower Spanish Fork River at Lake Shore resulting from the Proposed Action would be greater than baseline flow in all months. These greater flows would reflect the delivery of water to Utah Lake (i.e., both Bonneville Unit water and SFN System water for exchange to develop M&I water from groundwater and springs in southern Utah County). There would also be changes in flow in the upper reaches of the lower Spanish Fork River, resulting from the delivery of SFN System water via the Spanish Fork River. However, since substantial flows would continue to be diverted to the Power Canal, the changes in flow in the upper reaches would be smaller than at Lake Shore, and some reaches would continue to essentially be dewatered at times.

Flows in Spring Creek, Beer Creek, and Benjamin Slough would, on average, increase by about 8 percent from baseline conditions. This increase would reflect the increase in springflows in southern Utah Valley (see Section 3.2.6.3.2.2, which deals with groundwater quantity). Flows in West Creek and the flow through Burraston Ponds would increase by about 60 percent, and upper Currant Creek flows would increase about 55 percent from the baseline. This would reflect the increase in springflows in northern Juab Valley, also discussed in Section 3.2.6.3.2.2.

Reduced flows in Salt Creek would occur as a result of the related development of local distribution facilities on Salt Creek. These facilities would allow integration of additional diversions from Salt Creek with SFN System supplies. The flows resulting from the Proposed Action would be lower than baseline flows from April to September and the same as baseline flows in other months.

Table 3.2-5
Streamflows Resulting from the Proposed Action

Page 1 of 2

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Sixth Water Creek (Strawberry Tunnel to Sixth Water Tunnel)														
Change*	+7	+19	+20	+20	+20	+20	+18	-39	-183	-238	-160	-74		-34,614
Average Flow	34	27	27	27	27	28	34	49	43	36	34	34	25-131	24,197
Wet Year	35	28	28	27	29	28	59	88	53	37	36	35		29,170
Dry Year	34	27	27	27	27	27	28	36	32	32	33	34		21,849
Sixth Water Creek (Sixth Water Tunnel to Fifth Water Creek)														
Change*	+7	+20	+20	+20	+21	+20	+19	-39	-182	-239	-160	-74		-34,614
Average Flow	34	28	27	27	28	28	36	51	45	36	34	34	26-132	24,639
Wet Year	35	29	28	28	29	28	64	96	56	38	36	36		30,324
Dry Year	34	27	27	27	27	27	28	36	32	32	33	34		22,011
Sixth Water Creek (Fifth Water Creek to Three Forks)														
Change*	+7	+19	+20	+20	+20	+20	+18	-39	-182	-239	-160	-74		-34,614
Average Flow	38	31	31	30	31	33	50	77	57	40	37	37	26-184	29,731
Wet Year	39	33	33	31	33	33	117	184	89	46	42	41		43,637
Dry Year	37	31	29	30	30	30	32	42	32	32	34	37		23,889
Diamond Fork Creek (Three Forks to Red Hollow)														
Change*	+7	+24	+24	+25	+25	+25	+18	-40	-185	-243	-163	-75		-34,036
Average Flow	46	40	38	37	39	43	85	139	86	50	44	45	27-395	41,847
Wet Year	48	45	43	40	44	45	244	395	168	65	56	54		75,305
Dry Year	45	38	35	38	36	36	42	55	32	32	37	44		28,355
Diamond Fork Creek Below Red Hollow														
Change*	+21	+44	+46	+48	+46	+42	+21	-35	-143	-187	-127	-40		-16,339
Average Flow	60	60	60	60	60	60	88	144	128	106	80	80	60-395	59,544
Wet Year	60	60	60	60	60	60	244	395	168	80	80	80		85,016
Dry Year	60	60	60	60	60	60	60	80	80	80	80	80		49,505
Upper Spanish Fork River														
Change*	+21	+43	+46	+47	+46	+41	+21	-36	-142	-187	-127	-40		-16,322
Average Flow	114	113	114	114	128	154	267	427	262	176	155	138	88-1,895	130,756
Wet Year	112	108	108	120	128	149	1,079	1,895	570	269	218	188		299,226
Dry Year	93	94	91	93	99	107	100	119	100	103	116	115		74,255
Lower Spanish Fork River near Lake Shore														
Change*	+63	+65	+66	+67	+68	+64	+29	+76	+18	+13	+7	+22		+33,565
Average Flow	93	132	143	146	166	193	228	214	40	16	10	30	0-1,640	84,929
Wet Year	101	119	123	140	161	194	1,108	1,640	291	2	4	47		237,298
Dry Year	91	126	134	134	142	142	58	21	1	0	2	76		55,681
Beer Creek														
Change*	+2	+3	+3	+4	+6	+5	+4	+2	+1	+1	0	0		+1,802
Average Flow	31	37	42	52	78	74	47	19	9	5	4	9	0-256	24,397
Wet Year	31	35	39	56	82	75	256	56	14	5	5	12		40,005
Dry Year	10	21	26	33	37	40	28	2	2	0	0	0		11,858

Table 3.2-5
Streamflows Resulting from the Proposed Action

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Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Lower Currant Creek Below Mona Reservoir														
Change*	+7	+5	+7	+12	+28	+27	+5	+9	+22	+24	+16	+12	7-90	+10,432
Average Flow	22	23	10	16	34	40	28	69	69	66	47	37		27,890
Wet Year	23	25	31	83	90	82	43	73	72	71	52	40		41,412
Dry Year	21	23	9	9	8	38	26	67	67	67	49	37		25,605
Lower Currant Creek Below diversions														
Change*	+5	+6	+7	+13	+28	+27	+4	+6	+5	+6	+6	+6	8-91	+6,992
Average Flow	15	17	11	17	35	41	19	38	31	29	24	21		17,851
Wet Year	15	16	31	83	91	83	34	38	31	29	24	21		29,869
Dry Year	15	16	9	9	9	39	18	38	31	29	24	21		15,637
Salt Creek														
Change*	0	0	0	0	0	0	-30	-53	-36	-7	-2	-1	4-46	-7,787
Average Flow	10	12	10	10	11	14	18	21	16	15	13	10		9,645
Wet Year	9	8	8	8	10	13	46	46	38	16	16	16		14,197
Dry Year	6	8	8	8	7	7	6	15	12	6	6	6		5,737
Upper Currant Creek														
Change*	+6	+8	+7	+8	+11	+15	+15	+16	+9	+3	+3	+4	6-112	+6,368
Average Flow	17	21	21	21	31	42	42	45	26	10	9	11		17,849
Wet Year	19	24	25	24	36	108	111	112	92	12	11	12		35,378
Dry Year	16	21	21	21	31	40	41	44	24	10	9	11		17,436

*Change in average flow.

Mona Reservoir water level elevations, storage, and reservoir surface area would be greater than under baseline conditions except during the late summer. These increases would result from increased outflow from springs to Mona Reservoir, increased inflow from upper Currant Creek, and direct deliveries of additional water from the SFN System to Mona Reservoir. Slightly lower water levels (relative to the baseline) would occur in the late summer and reflect the greater releases made from the reservoir to serve the Elberta area and deliveries made to serve the west Mona area. The annual fluctuations in levels in Mona Reservoir under the Proposed Action would be greater than baseline. The average elevation in Mona Reservoir resulting from the Proposed Action would be 4,877.0 feet, an increase of 2.2 feet from the baseline elevation. Reservoir elevations with the Proposed Action would be higher than baseline elevations from October to May and lower from June to September. Reservoir storage and surface area impacts would show the same monthly pattern.

The average monthly flows in lower Currant Creek (both below Mona Reservoir and below the Currant Creek Irrigation Company diversions) under the Proposed Action would be increased from the baseline flows for every month. The increase would reflect the use of lower Currant Creek to convey irrigation water to the Elberta area and to convey Mona Reservoir spills and releases to Utah Lake.

3.2.6.3.2.2 Groundwater Quantity. Groundwater levels in southern Utah Valley beneath the highlands (lands above elevation 4,600) would average about 2 feet higher than baseline levels for the analysis period and would range from about 1 foot lower to 6 feet higher for individual years. The slight rise in average water levels under the Proposed Action would occur because the increased inflow to groundwater caused by irrigation return flows

(derived from the additional supplies delivered by the SFN System) would be greater than the reduction in inflow (resulting from improved on-farm and conveyance efficiencies) and the increase in discharge (resulting from increased pumping for M&I use and spring discharges).

Increased groundwater levels would also increase springflows by about 7 percent. Water level changes in the outflow areas of southern Utah Valley beneath the lake plains (lands below 4,600 feet) would be on the order of less than 1 foot. The change in water levels in the outflow area would be smaller than the change beneath the highlands because increases in groundwater levels in the outflow area would result in immediate increases in outflow to springs. The increased water levels could potentially result in additional flooding of basements in homes located on the lake plains. It is not possible to definitively state which homes that have historically been prone to basement flooding would flood more frequently or which additional homes (if any) might be affected. However, the relatively small magnitude of the water level increase (less than 1 foot) indicates that the magnitude of any additional flooding would be small.

Under the Proposed Action, groundwater levels beneath the edges of northern Juab Valley would average about 25 feet higher than baseline levels and could range from about 5 feet higher in the early years to about 30 feet higher from about project year 20 on. The rise in water levels would result from the substantial increase in inflows to groundwater from irrigation return flows derived from additional supplies delivered by the SFN System. While the actions related to the Proposed Action would improve on-farm and distribution system efficiencies (which would reduce the proportion of the water conveyed and delivered that inflows to groundwater), the irrigation return flows derived from SFN System deliveries would more than offset the reduction in inflow to groundwater caused by higher efficiencies. The water level rise would also increase the average springflow by about 55 percent or about 11,900 acre-feet. Because increases in water levels in the central portion of the valley would result in an immediate increase in outflow from springs, the potential water level change in the central portion of the valley would be substantially smaller, on the order of about 3 feet in the deeper confined zone and less than 1 foot in the upper unconfined zones. Since homes in the central part of the valley (where groundwater is close to ground surface) generally do not have basements, the increased levels probably would not impact these homes.

Groundwater levels in Goshen Valley under the Proposed Action would tend to be higher than the baseline levels. However, because the increase in inflow to groundwater as a result of the SFN System would be very small relative to the total existing inflow to groundwater, the magnitude of this increase would probably not be measurable, and the increase would not be anticipated to have an overall impact on water levels.

3.2.6.4 MCAPW-DFT Alternative

The MCAPW-DFT Alternative would make the same deliveries as the Proposed Action, result in the same irrigation return flows, and store the same amount of water in Mona Reservoir. However, it differs from the Proposed Action in that water for the Strawberry Water Users Association (SWUA) would be released from the end of the Diamond Fork Pipeline for conveyance in the upper Spanish Fork River rather than within the Main Conveyance Aqueduct. The discussion in this section is limited to the surface water quantity operation impacts in the upper Spanish Fork River because all other impacts of the MCAPW-DFT Alternative would be the same as those previously described for the Proposed Action. The impacts of the MCAPW-DFT Alternative are summarized in Section 3.2.6.10.

3.2.6.4.1 Surface Water Operation Impacts. Changes in flows in the upper Spanish Fork River resulting from the MCAPW-DFT Alternative are shown in Table 3.2-6. The flows would be greater than the baseline flows in every month as a result of the maintenance of minimum streamflows in Diamond Fork Creek, the conveyance of water to Utah Lake, and the conveyance of a portion of the SFN System water in the upper Spanish Fork River.

Table 3.2-6
Streamflows Resulting from the MCAPW-DFT Alternative

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Upper Spanish Fork River														
Change*	+84	+76	+78	+79	+81	+76	+39	+56	+77	+103	+65	+51		+52,097
Average Flow	177	146	146	146	163	189	285	519	481	466	347	229	101-1,913	199,175
Wet Year	186	141	140	152	165	181	1,079	1,913	718	540	374	344		359,304
Dry Year	136	126	123	124	134	139	101	241	377	340	205	202		135,784

*Change in average flow.

3.2.6.5 MCAP Alternative

The MCAP Alternative would make the same deliveries as the Proposed Action and would be operated in the same manner as the Proposed Action in eastern Juab County and in the Elberta area of southern Utah County. However, impacts in southern Utah County would differ those of the Proposed Action because of a number of differences in this alternative, including the following:

- Elimination of the "Diamond Fork Tunnel Alternative," resulting in greater conveyance of water in natural channels above the Diamond Fork Pipeline

- Construction of Monks Hollow Dam and Reservoir

- Direct delivery of SFN System M&I water in southern Utah County rather than pumping of groundwater and development of springs in exchange for deliveries to Utah Lake

- The release to Utah Lake would be reduced by an average of 12,200 acre-feet per year resulting from evaporation from Monks Hollow Reservoir and elimination of 11,200 acre-feet of exchange water for M&I supply from groundwater and springs

While the impacts of the MCAP Alternative are the same as those described for the Proposed Action in eastern Juab County and the Goshen Valley area of southern Utah County, discussion of the impacts at these locations is repeated in this section for ease of reference. The construction and operation impacts of the MCAP Alternative are summarized in Section 3.2.6.10.

3.2.6.5.1 Construction Impacts. Potential construction impacts on surface and groundwater quantities would occur through the use of water for construction activities. The total amount of water required for construction purposes would be less than 1,000 acre-feet. The contractor would obtain water required during construction from approved sources. Use of wells to obtain groundwater would be by agreement with well owners. Based on the limited amount of construction water required and the need to acquire water rights for this supply, the potential construction impact on water quantities would not be measurable.

3.2.6.5.2 Operation Impacts. Operation impacts in the categories of surface water quantities and groundwater quantities are presented in the sections that follow.

3.2.6.5.2.1 Surface Water Quantity. Monthly changes in average flows were quantified for surface water features that have quantified monthly baseline flows, as shown in Table 3.2-7. Monthly flows for wet and dry years are

also shown in Table 3.2-7. For those features without quantified monthly baseline flows (Spring Creek, Benjamin Slough, West Creek, and Burraston Ponds), the percentage change in flows was assessed based on the percentage change in outflow from springs that feed these features.

Table 3.2-7
Streamflows Resulting from the MCAP Alternative

Page 1 of 2

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Sixth Water Creek (Strawberry Tunnel to Sixth Water Tunnel)														
Change*	+7	+19	+20	+20	+20	+20	+18	-39	-186	-239	-160	-74		-34,873
Average Flow	34	27	27	27	27	28	34	49	40	35	34	34	26-88	23,938
Wet Year	35	28	28	27	28	28	59	88	53	37	36	35		29,168
Dry Year	34	27	27	27	27	27	28	36	32	32	33	34		21,895
Sixth Water Creek (Sixth Water Tunnel to Fifth Water Creek)														
Change*	+97	+55	+55	+54	+52	+43	+63	+182	+329	+357	+358	+195		+111,435
Average Flow	124	63	62	61	59	51	80	272	556	632	552	303	33-640	170,688
Wet Year	128	59	50	53	54	49	89	222	365	609	426	338		148,118
Dry Year	123	65	65	62	67	51	69	334	568	574	316	242		153,657
Sixth Water Creek (Fifth Water Creek to Three Forks)														
Change*	+96	+55	+54	+54	+51	+42	+62	+183	+329	+357	+358	+196		+111,437
Average Flow	127	67	65	64	62	55	94	299	568	636	555	307	41-650	175,782
Wet Year	132	64	55	57	58	54	142	310	398	617	432	344		161,432
Dry Year	126	68	68	66	69	54	73	340	568	574	318	245		155,534
Diamond Fork Creek (Three Forks to Red Hollow)														
Change*	+96	+59	+60	+60	+56	+48	+62	+181	+326	+353	+354	+194		+112,106
Average Flow	135	75	74	72	70	66	129	360	597	646	561	314	27-395	187,989
Wet Year	142	76	65	65	68	65	269	521	477	634	446	356		193,000
Dry Year	133	76	75	75	76	60	82	353	568	573	320	252		160,100
Diamond Fork Creek Below Red Hollow														
Change*	+21	+44	+46	+48	+46	+42	-7	-98	-141	-99	-126	-40		-16,203
Average Flow	60	60	60	60	60	60	60	81	130	194	81	80	60-357	59,680
Wet Year	60	60	60	60	60	60	60	80	80	122	80	80		52,180
Dry Year	60	60	60	60	60	60	60	80	80	80	80	80		49,505
Upper Spanish Fork River														
Change*	+22	+44	+46	+47	+46	+41	-7	-98	-141	-99	-126	-39		-16,206
Average Flow	115	114	114	114	128	154	239	365	263	264	156	139	87-1,580	130,872
Wet Year	113	107	107	120	130	149	896	1,580	483	311	219	187		266,516
Dry Year	92	94	91	92	100	106	100	118	99	103	117	115		74,053
Lower Spanish Fork River near Lake Shore														
Change*	+41	+41	+42	+43	+42	+40	+24	+24	+17	+13	+7	+22		+21,301
Average Flow	71	108	119	122	140	169	223	162	39	16	10	30	0-1,547	72,665
Wet Year	88	103	108	125	144	179	1,105	1,547	279	2	5	47		225,536
Dry Year	61	93	102	102	108	110	54	21	1	0	2	76		43,805
Beer Creek														
Change*	+5	+6	+7	+9	+14	+12	+8	+4	+2	+1	+1	+1		+4,189
Average Flow	34	40	46	57	86	81	51	21	10	5	5	10	0-275	26,784
Wet Year	33	38	42	61	89	81	275	61	15	6	6	13		43,053
Dry Year	11	25	30	39	43	47	33	2	2	0	0	0		13,915

Table 3.2-7
Streamflows Resulting from the MCAP Alternative

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Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Lower Currant Creek Below Mona Reservoir														
Change*	+7	+5	+7	+12	+28	+27	+5	+9	+22	+24	+16	+12		+10,432
Average Flow	22	23	10	16	34	40	28	69	69	66	47	37	7-90	27,890
Wet Year	23	25	31	83	90	82	43	73	72	71	52	40		41,412
Dry Year	21	23	9	9	8	38	26	67	67	67	49	37		25,605
Lower Currant Creek Below diversions														
Change*	+5	+6	+7	+13	+28	+27	+4	+6	+5	+6	+6	+6		+6,992
Average Flow	15	17	11	17	35	41	19	38	31	29	24	21	8-91	17,851
Wet Year	15	16	31	83	91	83	34	38	31	29	24	21		29,869
Dry Year	15	16	9	9	9	39	18	38	31	29	24	21		15,637
Salt Creek														
Change*	0	0	0	0	0	0	-30	-53	-36	-7	-2	-1		-7,787
Average Flow	10	12	10	10	11	14	18	21	16	15	13	10	4-46	9,645
Wet Year	9	8	8	8	10	13	46	46	38	16	16	16		14,197
Dry Year	6	8	8	8	7	7	6	15	12	6	6	6		5,737
Upper Currant Creek														
Change*	+6	+8	+7	+8	+11	+15	+15	+16	+9	+3	+3	+4		+6,368
Average Flow	17	21	21	21	31	42	42	45	26	10	9	11	6-112	17,849
Wet Year	19	24	25	24	36	108	111	112	92	12	11	12		35,378
Dry Year	16	21	21	21	31	40	41	44	24	10	9	11		17,436

*Change in average flow.

The changes from baseline flow in Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River would result, in part, from the maintenance of minimum flows in Sixth Water Creek and Diamond Fork Creek (as mandated by CUPCA), the conveyance of water to Utah Lake, the operation of Monks Hollow Dam and Reservoir, the conveyance of some SFN System water in these streams, and the conveyance of some of the existing flows in the Diamond Fork Pipeline and the SFN System Main Conveyance Aqueduct. During the winter, flows would increase relative to baseline conditions because of the CUPCA-mandated minimum flows in Diamond Fork Creek and water delivery to Utah Lake. Peak flows in the late spring and early summer in Sixth Water Creek from Strawberry Tunnel to Sixth Water Tunnel would be reduced from baseline conditions because releases from Strawberry Tunnel would be are reduced. Peak flows would also be reduced in Diamond Fork Creek below Red Hollow and the upper Spanish Fork River because much of the irrigation water would be conveyed in the Diamond Fork Pipeline and the SFN System Main Conveyance Aqueduct. However, peak flows would increase in Sixth Water Creek from Sixth Water Tunnel to Three Forks and in Diamond Fork Creek from Three Forks to Red Hollow, resulting from conveyance of SFN System and Bonneville Unit water in these reaches.

Flows in the lower Spanish Fork River at Lake Shore resulting from the MCAP Alternative would be greater than baseline flows in all months. These greater flows would reflect the delivery of water to Utah Lake. There would also be changes in the flows in the upper reaches of the lower Spanish Fork River, resulting from the delivery of SFN System water via the Spanish Fork River. However, since substantial flows would continue to be diverted to the Power Canal, the changes in flow in the upper reaches would be smaller than those at Lake Shore, and some reaches would continue to essentially be dewatered at times.

Flows in Spring Creek, Beer Creek, and Benjamin Slough would increase by about 19 percent from baseline conditions. This increase would reflect the increase in springflows in southern Utah Valley (see Section 3.2.6.5.2.2, which deals with groundwater quantity).

Flows in West Creek and the flow through Burraston Ponds would increase by about 60 percent, and upper Currant Creek flows would increase about 55 percent from the baseline. This would reflect the increase in springflows in northern Juab Valley, also discussed in Section 3.2.6.5.2.2.

Reduced flows in Salt Creek would occur as a result of the related development of local distribution facilities on Salt Creek. These facilities would allow integration of additional diversions from Salt Creek with SFN System supplies. The flows resulting from the MCAP Alternative would be lower than baseline flows from April to September and the same as baseline flows in other months.

Mona Reservoir water level elevations, storage, and reservoir surface area would be greater than those occurring under baseline conditions except during the late summer. These increases would result from increased outflow from springs to Mona Reservoir, increased inflow from upper Currant Creek, and direct deliveries of additional water from the SFN System to Mona Reservoir. Slightly lower water levels (relative to the baseline) would occur in the late summer and reflect the greater releases made from the reservoir to serve the Elberta area and deliveries to the west Mona area. The annual fluctuations in levels in Mona Reservoir under the MCAP Alternative would be greater than baseline. The average elevation in Mona Reservoir resulting from the MCAP Alternative would be 4,877.0 feet, an increase of 2.2 feet from the baseline elevation. Reservoir elevations with the MCAP Alternative would be higher than baseline elevations from October to May and lower from June to September. Reservoir storage and surface area impacts would show the same monthly pattern.

The average monthly flows in lower Currant Creek (both below Mona Reservoir and below the Currant Creek Irrigation Company diversions) under the MCAP Alternative would increase from the baseline flows for every month. This increase reflects the use of lower Currant Creek to convey irrigation water to the Elberta area and to convey Mona Reservoir spills and releases to Utah Lake.

3.2.6.5.2.2 Groundwater Quantity. Groundwater levels in southern Utah Valley beneath the highlands (lands above elevation 4,600) would average about 6 feet higher than baseline levels for the analysis period and would range from about 3 to 11 feet higher on average for individual years. The slight rise in water levels under the MCAP Alternative would occur because the increased inflow to groundwater caused by irrigation return flows derived from the additional supplies delivered by the SFN System would be greater than reductions in inflows resulting from improved on-farm and conveyance efficiencies.

Increased water levels would also increase springflows by about 18 percent on average. Water level changes in the outflow areas of southern Utah Valley beneath the lake plains (lands below 4,600 feet) would be on the order of less than 1 foot. The change in water levels in the outflow area would be smaller than the change beneath the highlands because increases in groundwater levels in the outflow area would result in immediate increases in outflow to springs. The increased water levels could potentially result in additional flooding of basements in homes located on the lake plains. It is not possible to definitively state which homes that have historically been prone to basement flooding would flood more frequently or which additional homes (if any) might be affected. However, the relatively small magnitude of the water level increase (less than 1 foot) indicates that the magnitude of any additional flooding would be small.

Under the MCAP Alternative, groundwater levels beneath the edges of northern Juab Valley would average about 25 feet higher than baseline levels and could range from about 5 feet higher in the early years to about 30 feet higher from about project year 20 on. The rise in water levels would result from the substantial increase in inflows to groundwater from irrigation return flows derived from additional supplies delivered by the SFN System. While the actions related to the MCAP Alternative would improve on-farm and distribution system efficiencies

(which would reduce the proportion of the water conveyed and delivered that inflows to groundwater), the irrigation return flows derived from SFN System deliveries would more than offset the reduction in inflow to groundwater caused by higher efficiencies. The water level rise would also increase the average springflow by about 55 percent or about 11,900 acre-feet. Because increases in water levels in the central portion of the valley would result in an immediate increase in outflow from springs, the potential water level change in the central portion of the valley would be substantially smaller, on the order of about 3 feet in the deeper confined zone and less than 1 foot in the upper unconfined zones. Since homes in the central part of the valley (where groundwater is close to ground surface) generally do not have basements, the increased levels probably would not impact these homes.

Groundwater levels in Goshen Valley would tend to be higher than the baseline levels. However, because the increase in inflow to groundwater as a result of the SFN System would be very small relative to the total existing inflow to groundwater, the magnitude of this increase would probably not be measurable, and the increase would not be anticipated to have an overall impact on water levels.

3.2.6.6 MCAPW Alternative

The impacts of the MCAPW Alternative would be the same as those previously described for the MCAP Alternative (see Section 3.2.6.5), except for the upper Spanish Fork River. Flows in the upper Spanish Fork River would differ from those of the MCAP Alternative because SVP and Bonneville Unit water for agricultural lands served by the SVP would be released from the end of the Diamond Fork Pipeline to the Spanish Fork River rather than to the Main Conveyance Aqueduct. Impacts resulting from the MCAPW Alternative are summarized in Section 3.2.6.10.

3.2.6.6.1 Surface Water Quantity. Changes in the flows in the upper Spanish Fork River resulting from the MCAPW Alternative are shown in Table 3.2-8. The increased flows in every month would result from SVP and Bonneville Unit water conveyed in the upper Spanish Fork River.

Table 3.2-8
Streamflows Resulting from the MCAPW Alternative

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Upper Spanish Fork River														
Change*	+54	+44	+46	+48	+46	+44	+36	+51	+74	+104	+64	+50		+40,007
Average Flow	147	114	114	115	128	157	282	514	478	467	346	228	88-1,913	187,085
Wet Year	155	108	108	120	131	150	1,076	1,913	719	542	372	345		347,512
Dry Year	106	94	92	93	99	108	101	241	377	340	200	203		124,039

*Change in average flow.

3.2.6.7 MCATC Alternative

The impacts of the MCATC Alternative would be the same as those described for the MCAP Alternative. These impacts are summarized in Section 3.2.6.10.

3.2.6.8 MCAT Alternative

The impacts of the MCAT Alternative would be the same as those previously described for the MCAP Alternative, except for the upper Spanish Fork River. Flows in the upper Spanish Fork River differ from those in the MCAP Alternative because SVP and Bonneville Unit water for agricultural lands served by the SVP would be released from the end of the Diamond Fork Pipeline to the Spanish Fork River rather than to the Main Conveyance Aqueduct. Impacts are summarized in Section 3.2.6.10.

3.2.6.8.1 Surface Water Quantity. Changes in flows in the upper Spanish Fork River resulting from the MCAT Alternative are shown in Table 3.2-9. The flows would be greater than baseline flows in every month as a result of the maintenance of minimum streamflows in Diamond Fork Creek, the conveyance of water to Utah Lake, and the conveyance of a portion of SFN System water in the upper Spanish Fork River.

Table 3.2-9
Streamflows Resulting from the MCAT Alternative

Feature	Monthly Flows (cfs)												Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Upper Spanish Fork River														
Change*	+65	+44	+46	+47	+45	+44	+36	+60	+118	+164	+93	+60		+49,900
Flow	158	114	114	114	127	157	282	523	522	527	375	238	89-1,915	196,978
Wet Year	167	107	107	120	125	149	1,076	1,915	726	587	388	352		352,801
Dry Year	123	94	91	92	100	106	100	267	425	420	242	226		138,275

*Change in average flow.

3.2.6.9 No Action Alternative

The No Action Alternative would result in changes to surface and groundwater quantities. These changes would be limited to southern Utah Valley, as the No Action Alternative would make no deliveries to eastern Juab County or to the Goshen Valley area of southern Utah County. There would be no changes in irrigation or distribution system facilities from baseline conditions as a result of the No Action Alternative. Impacts of the No Action Alternative are summarized in Section 3.2.6.10.

3.2.6.9.1 Surface Water Quantity. Changes in surface water flows were quantified for features with quantified monthly baseline flows, as shown in Table 3.2-10. For Spring Creek and Benjamin Slough, the percentage changes in flow were assessed based on the percentage change in the flows from springs that feed these features.

The flow in Sixth Water Creek between Strawberry Tunnel and Sixth Water Tunnel would be increased from baseline from October to April (resulting from releases from Strawberry Tunnel to maintain minimum flows) and decreased from baseline from May to September (resulting from reduced releases of irrigation water from Strawberry Tunnel). Flows between Sixth Water Tunnel and Red Hollow would be higher than baseline in every month, resulting from the increased releases from Sixth Water Tunnel.

Both the average and peak flow in Diamond Fork Creek below Red Hollow would be reduced from baseline flows because a portion of the flow would be diverted to the Diamond Fork Pipeline. Flows during the low flow months of October through March would be greater than baseline because of the maintenance of CUPCA-mandated minimum streamflows.

Table 3.2-10
Streamflows Resulting from the No Action Alternative

Feature	Monthly Flows (cfs) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Range of Monthly Flows (cfs)	Annual Flow (ac-ft/yr)
Sixth Water Creek (Strawberry Tunnel to Sixth Water Tunnel)														
Change*	+7	+19	+20	+20	+20	+20	+18	-39	-186	-239	-160	-74		-34,873
Average Flow	34	27	27	27	27	28	34	49	40	35	34	34	26-88	23,938
Wet Year	35	28	28	27	28	28	59	88	53	37	36	35		29,168
Dry Year	34	27	27	27	27	27	28	36	32	32	33	34		21,895
Sixth Water Creek (Sixth Water Tunnel to Fifth Water Creek)														
Change*	+39	+260	+272	+278	+270	+242	+94	+40	+37	+48	+57	+128		105,855
Average Flow	66	268	279	285	274	250	111	130	264	323	251	236	39-450	165,108
Wet Year	55	237	251	269	252	242	80	96	177	308	310	228		151,668
Dry Year	55	273	294	276	286	285	248	166	327	223	123	164		163,557
Sixth Water Creek (Fifth Water Creek to Three Forks)														
Change*	+39	+260	+272	+278	+270	+242	+95	+43	+38	+49	+57	+128		106,298
Average Flow	70	272	283	288	281	255	127	159	277	328	254	239	52-452	170,643
Wet Year	59	243	256	273	266	247	138	192	213	317	317	234		166,138
Dry Year	59	276	297	279	289	288	252	172	327	223	124	167		165,596
Diamond Fork Creek (Three Forks to Red Hollow)														
Change*	+39	+265	+276	+283	+275	+247	+95	+42	+35	+45	+54	+126		106,876
Average Flow	78	281	290	295	289	265	162	221	306	338	261	246	61-455	182,759
Wet Year	68	254	266	281	277	258	265	403	292	336	331	246		197,806
Dry Year	66	284	302	287	295	295	262	185	327	223	127	174		170,062
Diamond Fork Creek Below Red Hollow														
Change*	+21	+44	+46	+48	+46	+42	+21	-35	-172	-213	-127	-40		-19,648
Average Flow	60	60	60	60	60	60	88	144	99	80	80	80	60-395	56,235
Wet Year	60	60	60	60	60	60	244	395	168	80	80	80		85,135
Dry Year	60	60	60	60	60	60	60	80	80	80	80	80		49,505
Upper Spanish Fork River														
Change*	+39	+264	+277	+282	+272	+247	+96	+42	+36	+45	+54	+127		+106,887
Average Flow	132	334	345	349	354	360	342	505	440	408	336	305	88-1,903	253,965
Wet Year	121	302	314	342	332	348	1,100	1,903	694	524	469	354		412,016
Dry Year	99	318	334	320	334	342	302	224	347	246	164	209		194,812
Lower Spanish Fork River near Lake Shore														
Change*	+28	+261	+272	+278	+269	+243	+84	+17	0	0	+2	+104		+93,312
Average Flow	58	328	349	357	367	372	283	155	22	3	5	112	0-1,538	144,676
Wet Year	56	298	314	347	355	378	1,130	1,538	279	2	92	57		292,422
Dry Year	55	317	344	329	343	345	256	5	1	0	2	104		125,843
Beer Creek														
Change*	0	0	+1	0	+1	0	0	0	0	0	0	0		+77
Average Flow	29	34	40	48	73	69	43	17	8	4	4	9	0-244	22,672
Wet Year	29	34	37	54	78	72	244	54	13	5	5	12		38,100
Dry Year	10	21	26	33	37	40	28	2	2	0	0	0		11,858

*Change in average flow.

Flows in the upper Spanish Fork River would be greater than baseline flows in every month because of increased flows resulting from the minimum flows in Diamond Fork Creek and the release to the upper Spanish Fork River of all water carried in the Diamond Fork Pipeline.

Flows in the lower Spanish Fork River at Lake Shore would be higher than baseline flows in every month except July because of the minimum flows in Diamond Fork Creek and conveyance of flows to Utah Lake. Flows in July would be unchanged from baseline because all additional flows would be diverted for irrigation and M&I use.

The inflow to Utah Lake would increase by about 93,300 acre-feet per year as a result of the No Action Alternative because of the delivery of about 11,200 acre-feet of M&I water for exchange to wells and springs in southern Utah County and 82,100 acre-feet delivered to Utah Lake for exchange to Jordanelle Reservoir. The impact to Utah Lake would be essentially the same as the cumulative impact for the Proposed Action described previously in Section 2.3.3.1.

3.2.6.9.2 Groundwater Quantity. The No Action Alternative would result in a small (about 1 foot) rise in groundwater levels beneath the highlands along the margins of southern Utah Valley in a few years. The rise in levels beneath the lake plains closer to Utah Lake would be less than 1 foot. On average, there would be no increase in the discharges from springs, although the discharges would increase (by less than 5 percent) in some individual years.

3.2.6.10 Summary of Significant Impacts

Table 3.2-11 presents a summary of significant impacts (i.e., changes from baseline) for the Proposed Action and alternatives. It is noted that impacts are frequently the same for various alternatives, which reflects that these alternatives have been constructed with discrete components that influence these impacts. However, the No Action Alternative generally has unique impacts because it has a different water supply than the other alternatives.

Flows in Sixth Water Creek and Diamond Fork Creek above Red Hollow would vary, depending on whether the alternative includes construction of the "Diamond Fork Tunnel Alternative" (Proposed Action and MCAPW-DFT Alternative) or construction of Monks Hollow Dam (MCAP, MCAPW, MCATC, and MCAT Alternatives). The "Diamond Fork Tunnel Alternative" would result in increases from baseline flows from October through April, decreases from baseline flows from May through September, and an overall reduction in the annual flow. Alternatives that include the construction of Monks Hollow Dam would result in increases from baseline flows in all months.

Flows in Diamond Fork Creek below Red Hollow (i.e., after diversions into the Diamond Fork Pipeline) would also vary, depending on whether the alternative includes construction of the "Diamond Fork Tunnel Alternative" or Monks Hollow Dam. However, the general monthly pattern of these impacts would be similar for both, with increased flows at times (October through April with the "Diamond Fork Tunnel Alternative" and October through March with Monks Hollow Dam) and decreased flows at other times.

Flows in the upper Spanish Fork River would vary for most of the alternatives (with only the MCAP and MCATC Alternatives having the same flows). Upper Spanish Fork River flows would depend several factors, including:

- Whether SVP water would be conveyed in the Main Conveyance Aqueduct (Proposed Action and MCAP and MCATC Alternatives) or discharged to the upper Spanish Fork River at the end of the Diamond Fork Pipeline (MCAPW-DFT, MCAPW, and MCAT Alternatives)

- Whether SFN System M&I deliveries would be made through exchange with Utah Lake (Proposed Action and MCAPW-DFT Alternative) or directly (MCAP, MCAPW, MCATC, and MCAT Alternatives)

Table 3.2-11
Summary of Significant Impacts on Water Quantities

Resource	Unit	Baseline Quantity	Proposed Action		MCAPW-DFT Alternative		MCAP Alternative		MCAPW Alternative		MCATC Alternative		MCAT Alternative		No Action Alternative	
			Impact	Quantity	Impact	Quantity	Impact	Quantity	Impact	Quantity	Impact	Quantity	Impact	Quantity	Impact	Quantity
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	ac-ft/yr	58,811	-34,614	24,197	-34,614	24,117	-34,873	23,938	-34,873	23,938	-34,873	23,938	-34,873	23,938	-34,873	23,938
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	ac-ft/yr	59,253	-34,614	24,639	-34,614	24,639	+111,435	170,668	+111,435	170,668	+111,435	170,668	+111,435	170,688	105,855	165,108
Sixth Water Creek: Fifth Water Creek to Three Forks	ac-ft/yr	64,345	-34,614	29,731	-34,614	29,731	+111,437	175,782	+111,437	175,782	+111,437	175,782	+111,437	175,782	160,298	170,643
Diamond Fork Creek: Three Forks to Red Hollow	ac-ft/yr	75,883	-34,036	41,847	-34,036	41,847	+112,106	187,989	+112,106	187,989	+112,106	187,989	+112,106	187,989	106,876	182,759
Diamond Fork Creek: Red Hollow to Spanish Fork River	ac-ft/yr	75,883	-16,339	59,544	-16,339	59,544	-16,203	59,680	-16,203	59,680	-16,203	59,680	-16,203	59,680	-19,648	56,235
Upper Spanish Fork River	ac-ft/yr	147,078	-16,322	130,756	52,097	199,175	-16,206	130,872	40,007	187,085	-16,206	130,872	49,900	196,978	106,887	253,965
Lower Spanish Fork River Near Lake Shore	ac-ft/yr	51,364	33,565	84,929	33,565	84,929	21,301	72,665	21,301	72,665	21,301	72,665	21,301	72,665	93,312	144,676
Spring Creek	ac-ft/yr	8,000	600	8,600	600	8,600	1,400	9,400	1,400	9,400	1,400	9,400	1,400	9,400	0	8,000
Beer Creek	ac-ft/yr	22,595	1,802	24,397	1,802	24,397	4,189	26,784	4,189	26,784	4,189	26,784	4,189	26,784	77	22,672
Benjamin Slough	ac-ft/yr	47,000	3,300	50,300	3,300	50,300	8,500	55,500	8,500	55,500	8,500	55,500	8,500	55,500	0	47,000
Salt Creek	ac-ft/yr	17,432	-7,787	9,645	-7,787	9,645	-7,787	9,645	-7,787	9,645	-7,787	9,645	-7,787	9,645	0	17,432
West Creek	ac-ft/yr	1,500	900	2,400	900	2,400	900	2,400	900	2,400	900	2,400	900	2,400	0	1,500
Burraston Ponds	ac-ft/yr	1,000	600	1,600	600	1,600	900	1,600	900	1,600	600	1,600	600	1,600	0	1,000
Upper Currant Creek	ac-ft/yr	11,481	6,368	17,849	6,368	17,849	6,368	17,849	6,368	17,849	6,368	17,849	6,368	17,849	0	11,481
Lower Currant Creek Below Mona Reservoir	ac-ft/yr	17,458	10,432	27,890	10,432	27,890	10,432	27,890	10,432	27,890	10,432	27,890	10,432	27,890	0	17,458
Lower Currant Creek Below Diversions	ac-ft/yr	10,859	6,992	17,851	6,992	17,851	6,992	17,851	6,992	17,851	6,992	17,851	6,992	17,851	0	10,859
Mona Reservoir	feet above msl	4,875.2	1.8	4,877.0	1.8	4,877.0	1.8	4,877.0	1.8	4,877.0	1.8	4,877.0	1.8	4,877.0	0	4,875.2
Utah Lake*	feet above msl	No Measurable Change														
Southern Utah Valley Groundwater Level	feet above msl	4,572	2	4,574	2	4,574	6	4,578	6	4,578	6	4,578	6	4,578	0	4,572
Goshen Valley Groundwater Level	feet above msl	No Measurable Change														
Northern Juab Valley Groundwater Level	feet above msl	4,921	25	4,946	25	4946	25	4,946	25	4,946	25	4,946	25	4,946	0	4,921

*There are no measurable impacts on Utah Lake from the Proposed Action or alternatives. Total impacts of deliveries made to Utah Lake for exchange to Jordanelle Reservoir are presented in Chapter 2.

Table 3.2-11
Summary of Significant Impacts on Water Quantities

- Whether the alternative would use the Main Conveyance Aqueduct Pipeline (Proposed Action and MCAPW-DFT, MCAP, and MCAPW Alternatives) or the Main Conveyance Aqueduct Tunnel (MCATC and MCAT Alternatives)

The flows in the upper Spanish Fork River would result from the interaction of these factors for each alternative. Flows in the lower Spanish Fork River would be higher than baseline for all alternatives, but the increase would be greater for alternatives in which M&I deliveries would be made by exchange with Utah Lake (Proposed Action and MCAPW-DFT Alternative) than for alternatives in which direct M&I deliveries would be made (MCAP, MCAPW, MCATC, and MCAT Alternative deliveries).

Flows in Beer Creek, Spring Creek, and Benjamin Slough would result from changes in discharges from springs, which would depend on the groundwater hydrologic budget. Alternatives with the M&I exchange would have a smaller increase in spring discharges than the alternatives with direct M&I deliveries, reflecting the additional groundwater pumping for M&I deliveries.

Because all of the alternatives would provide the same water supply and have the same operations, impacts in eastern Juab County and the Goshen Valley area of southern Utah County would be the same for the Proposed Action and all alternatives (except the No Action Alternative, which would have no impact).

3.2.7 Cumulative Impacts

The projects considered for cumulative impacts, identified in Section 1.8, would not be expected to impact surface water or groundwater quantity. Therefore, the cumulative impacts would be the same as the SFN System impacts summarized in Section 3.2.6.10. The one exception is Utah Lake, which is addressed in Chapter 2.

- Whether the alternative would use the Main Conveyance Pipeline (Proposed Action and MCAPW-DPT, MC-II, and MCAPW Alternatives) or the Main Conveyance Aqueduct Tunnel (MCA-TC and MCAT Alternatives).

The flows in the upper Spanish Fork River would result from the interaction of these factors for each alternative. Flows in the lower Spanish Fork River would be higher than baseline for all alternatives, but the increase would be greater for alternatives in which M&I deliveries would be made in exchange with Utah Lake (Proposed Action and MCAPW-DPT Alternatives) than for alternatives in which direct M&I deliveries would be made (MC-II, MCAPW, MCA-TC, and MCAT Alternative deliveries).

Flows in Beer Creek, Spring Creek, and Benjamin Slough would result from changes in discharges from springs, which would depend on the groundwater (elevation) budget. Alternatives with the M&I exchange would have a smaller decrease in spring discharges than the alternatives with direct M&I deliveries, reflecting the additional groundwater pumping for M&I deliveries.

Because all of the alternatives would provide the same water supply and have the same operations for areas in central Utah County and the Goshen Valley area of southern Utah County would be the same for the Proposed Action and all alternatives (except the No Action Alternative, which would have no impact).

3.2.7 Cumulative Impacts

The projects considered for cumulative impacts, identified in Section 1.8, would not be expected to impact surface water or groundwater quantity. Therefore, the cumulative impacts would be the same as the SFN system impacts summarized in Section 3.2.6.10. The one exception is Utah Lake, which is addressed in Chapter 5.

3.3 Water Quality

3.3.1 Introduction

The information and analysis provided in this section was summarized from the *Hydrology and Water Resources Technical Report* (CUWCD 1998b), *Sediment Study for the No Monks Hollow Alternative–SFN System EIS* (CUWCD 1997b), and the *Environmental Contaminants Technical Report* (CUWCD 1997a). This section discusses potential impacts to surface water and groundwater quality from the construction, operation, and maintenance of the SFN System and related local distribution and on-farm systems.

3.3.2 Issues Eliminated from Further Analysis

Water quality of SFN System water delivered for M&I use relative to drinking water standards is not addressed in this section since it is the local entities' responsibility to ensure that water meets applicable water quality standards. Some issues raised during the public scoping process regarding the operation of Strawberry Reservoir have been excluded from this analysis. The water quality of Strawberry Reservoir was previously described in the *Bonneville Unit Definite Plan Report* (USBR 1964) and the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984). These documents indicated that Strawberry Reservoir (before its enlargement) had good water quality, except for high nutrient concentrations and resultant eutrophication. The enlargement was anticipated to improve water quality in Strawberry Reservoir by dilution of the high nutrient concentrations resulting from increased inflow to the reservoir. The effects of the enlarged Strawberry Reservoir on temperatures of releases were also evaluated, including estimating the percentage of years that would release warm water from above the thermocline, cool water from below the thermocline, or a mix of these waters. These effects result from operations of Strawberry Reservoir and, as discussed previously in Section 3.2.2, operations for these alternatives are essentially unchanged from operations described previously.

The issue of water quality problems in Thistle Creek that could limit the potential for improvement of the lower Spanish Fork River was not directly addressed, as Thistle Creek is not included in the impact area of influence. However, the effects that Thistle Creek's water quality has on the Spanish Fork River were indirectly addressed because baseline flows and water quality data incorporate inflow from Thistle Creek. Water quality in Utah Lake is discussed in Chapter 2 of this DEIS.

3.3.3 Issues Addressed in the Impact Analysis

The issues addressed in the impact analysis for water quality include surface and groundwater quality. Issues identified in the scoping process include the following:

- Potential sediment load in SFN System water
- Impacts of releases from Strawberry Reservoir
- Impacts of recharge and irrigation return flows on groundwater quality

Listed below are issues not identified during the public scoping process that are addressed in this section.

- Potential for increases in contaminants, such as selenium, resulting from irrigation water deliveries associated with the SFN System

3.3.4 Description of Impact Area of Influence

The impact area of influence for water quality includes those hydrologic features in southern Utah County and eastern Juab County that would convey SFN System water, receive water derived from SFN System deliveries,

or have modified diversions in order to integrate existing flows with the SFN System. This includes the same major hydrologic features considered for water quantity.

3.3.5 Affected Environment

The water quality of the hydrologic features identified in the impact area of influence could be affected by the construction and operation of the SFN System and distribution and on-farm systems. The affected environments for these features are presented in Sections 3.3.5.1 (surface water quality) and 3.3.5.2 (groundwater quality). Strawberry Reservoir is not included in the impact area of influence because the SFN System would not significantly change the quality of water in Strawberry Reservoir. However, water from Strawberry Reservoir is included in the discussion of surface water quality because it would mix with natural flows while being conveyed to SFN System delivery points.

Several "key" parameters were used to assess water quality: salinity (as measured by total dissolved solids [TDS], which is a measurement of the quantity of minerals dissolved in the water), pH, dissolved oxygen, temperature, biological oxygen demand [BOD], nitrate, total ammonia, total phosphorus, coliforms, turbidity, and selenium. These parameters are included in the water quality standards set by the State of Utah and were selected to provide information used to evaluate related impacts to other resources. Both the average level and the maximum level of the key parameters are presented in this section (except that the minimum level of dissolved oxygen is presented because the standard is for minimum dissolved oxygen). Average levels of these parameters indicate whether water generally meets water quality standards, while the maximum levels show whether there are occasional exceedences of water quality standards. A separate sedimentation evaluation (CUWCD 1997f) was limited to the Diamond Fork drainage. A separate contaminants evaluation (CUWCD 1997a) was limited to the lower watershed areas of Juab County and southern Utah County.

Water quality was evaluated in relation to the *Standards of Quality for Waters of the State* (Utah Department of Environmental Quality 1994). Water quality standards vary by the uses of water. The water quality standards by key water quality parameters and water use classifications are summarized in Table 3.3-1. Water use classifications of the major hydrologic features in the impact area of influence are summarized in Table 3.3-2. West Creek is not classified under the water quality standards.

3.3.5.1 Surface Water Quality

Water quality for each surface water feature is dependant on several processes. Water quality depends, in part, on the blend of the various source waters that contribute flows to each feature. Temperatures and phosphorus in waters receiving Strawberry Reservoir water will be influenced by the thermocline (a temperature stratification in the reservoir that is present from about May to October) in Strawberry Reservoir (USBR 1988d). Water released from above the thermocline has warmer temperatures and lower phosphorus concentrations than water released from below the thermocline. Cooler temperatures also allow more oxygen to be dissolved.

Water quality can also be influenced by the rate of flow. Stagnant pools of water exhibit higher summer temperatures and lower levels of dissolved oxygen. Higher flow rates produce greater aeration. Turbidity and total phosphorus can also increase as a result of increased erosion. In the upper Spanish Fork River, high turbidity is associated with high flows resulting from spring runoff and heavy rainstorms, as well as from high flow releases for delivery of irrigation waters. During storm events, turbid water from Halls Fork, Diamond Fork, Soldier Creek, and the Thistle Creek slide area can also result in turbidity problems in the upper Spanish Fork River (Sakaguchi 1993).

Baseline water quality conditions for the various surface water features in the impact area of influence are summarized in Table 3.3-3. These conditions are based on water quality from *1988 Supplement to the 1964*

Definite Plan Report, Water Quality Appendix, Vol. 1 (USBR 1988d); *Environmental Contaminants Technical Report* (CUWCD 1997a); *Utah Lake Phase 1, Report 26* (Miller 1980); basic data from the Utah Department of Environmental Quality (1994); *Final Report Jordan River and Tributary System Water Quality Data Update and Study* (Eckhoff, Watson, Preator Engineering 1986); and basic data from the U.S. Geological Survey and USBR.

Table 3.3-1
State of Utah Water Quality Standards by Key Parameters and Water Use Classification

Key Water Quality Parameters	Units	Water Use Classification						
		1C Domestic	2B Recreation (Secondary Contact)	3A Coldwater Game Fishery	3B Warmwater Game Fishery	3C Non-Game Fishery	3D Waterfowl Fishery	4 Agriculture
Total Dissolved Solids[a] (TDS)	ppm	No standard	No standard	No standard	No standard	No standard	No standard	1,200
Minimum pH		6.5	6.5	6.5	6.5	6.5	6.5	6.5
Maximum pH		9.0	9.0	9.0	9.0	9.0	9.0	9.0
Minimum Dissolved Oxygen[b] (30-day average)	ppm	5.5	5.5	6.5	5.5	5.0	5.0	No standard
Maximum Temperature	°F	No standard	No standard	68	81	81	No standard	No standard
Biologic Oxygen Demand (BOD)	ppm	No standard	5	No standard	No standard	No standard	No standard	5
Nitrate as N	ppm	10	4	4	4	4	4	No standard
Total Ammonia as N[c] (4-day average)	ppm	No standard	No standard	c	c	No standard	No standard	No standard
Phosphate as Phosphorus (streams)	ppm	.05	.05	.05	.05	.05	.05	No standard
Phosphate as Phosphorus (lake and reservoirs)	ppm	.025	0.025	0.025	0.025	0.025	0.025	No standard
Maximum Total Coliforms	count	5,000	5,000	No standard	No standard	No standard	No standard	No standard
Maximum Fecal Coliforms	count	2,000	2,000	No standard	No standard	No standard	No standard	No standard
Turbidity Increase	NTU	No standard	10	10	10	15	15	No standard

[a]Limits may be adjusted if such adjustment does not impair the designated beneficial use of the receiving water.
[b]These limits are not applicable to lower water levels in deep impoundments. The 30-day standard is used in this report as it corresponds with the monthly time step used for analysis.
[c]Temperature- and pH-dependent.
Source: *Standards of Quality for Waters of the State* (Utah Department of Environmental Quality 1994)

Table 3.3-2 State of Utah Water Use Classification of Hydrologic Features in the Impact Area of Influence							
	Water Use Classification						
Affected Water Features	1C Domestic	2B Recreation (Secondary Contact)	3A Coldwater Game Fishery	3B Warmwater Game Fishery	3C Non-Game Fishery	3D Waterfowl Fishery	4 Agriculture
Sixth Water Creek		X	X				X
Diamond Fork Creek		X	X				X
Upper Spanish Fork River		X	X				X
Lower Spanish Fork River		X		X		X	X
Spring Creek		X			X		X
Beer Creek		X			X		X
Benjamin Slough		X		X			X
Lower Currant Creek		X	X				X
Salt Creek		X	X				X
West Creek		*	*	*	*	*	*
Burraston Ponds		X	X				X
Upper Currant Creek		X	X				X
Mona Reservoir		X		X			X
*West Creek is not presently classified under the State water quality standards.							

The basic data from the USBR, covering the period 1978 to 1982, for Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River was in a form appropriate for flow-weighting. Both the arithmetic and flow-weighted average quality for these locations are shown in Table 3.3-3. The water quality impact analysis is based on flow-weighted averages where available. Turbidity data in nephelometric turbidity units (NTU) were not available for upper Diamond Fork and Sixth Water Creeks; therefore, total suspended solids (TSS) in milligrams per liter (mg/L) are used in the tables.

Compliance of baseline water quality with water quality standards was evaluated, with average water quality indicating general compliance with the standards and maximum (or minimum for dissolved oxygen) concentrations indicating if there are periodic exceedences of the standard. The average water quality generally meets all standards except for the following key parameters:

- Phosphorus, which exceeds the standard for all surface waters except Sixth Water Creek from Strawberry Tunnel to Fifth Water Creek, Salt Creek, and lower Currant Creek below diversions

- Total coliforms, which exceeds the standard in Benjamin Slough

Table 3.3-3
Surface Water Quality Baseline Conditions for Southern Utah County and Eastern Juab County

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Key Water Quality Parameters	Southern Utah County												Eastern Juab County			
	Sixth Water Creek			Diamond Fork Creek		Upper Spanish Fork River	Lower Spanish Fork River	Spring Creek	Beer Creek	Benjamin Slough	Lower Currant Creek					
	Strawberry Tunnel to Sixth Water Tunnel	Sixth Water Tunnel to Fifth Water Creek	Fifth Water Creek to Three Forks	Three Forks to Red Hollow[a]	Red Hollow to Spanish Fork River						Above Diversions	Below Diversions	Salt Creek	West Creek	Upper Currant Creek[a]	Mona Reservoir
TDS (ppm)																
Average	231	237	306	272	272	355	510	528	795	998	966	899	610	2,271	977	864
Flow-Weighted Average	183	196	222	213	213	301	b	b	b	b	b	908	b	b	b	b
Maximum	274	294	432	383	383	489	1,260	1,116	1,560	1,614	1,152	1,040	5,470	10,400	3,500	1,120
pH																
Average	8.2	8.3	8.3	8.3	8.3	8.2	8.1	8.2	7.9	8.4	8.2	8.5	8.3	8.8	8.1	8.3
Flow-Weighted Average	8.1	8.1	8.2	8.1	8.1	8.2	b	b	b	b	b	8.4	b	b	b	b
Maximum	8.6	8.5	8.6	8.6	8.6	8.5	9.0	8.6	8.6	8.5	8.6	9.0	8.5	9.5	8.7	8.9
Dissolved Oxygen (ppm)																
Average	7.2	No data	9.4	7.6	7.6	8.0	8.5	9.2	8.1	12.9	9.1	8.7	9.2	14.0	9.3	7.6
Flow-Weighted Average	7.3	No data	9.4	7.0	7.0	8.0	b	b	b	b	b	8.0	b	b	b	b
Minimum	7.0	No data	8.8	2.2	2.2	4.3	0.3	4.7	1.9	8.8	5.0	12.8	6.7	No data	7.3	3.5
Temperature (°F)																
Average	48	48[c]	49	49	49	52	57	48	54	57	59	62	48	73	57	63
Flow-Weighted Average	59	59[c]	58	57	57	57	60	b	b	b	b	63	b	b	b	b
Maximum	67	67[c]	70	70	70	75	84	77	82	75	88	77	70	86	88	73
BOD (ppm)																
5-Day Average	3.2	2.4	1.2	1.6	1.6	d	No data	No data	No data	3.0	No data	No data	No data	No data	No data	No data
Flow-Weighted Average	d	d	1.2	1.6	1.6	3.0	b	b	b	b	b	b	b	b	b	b
Maximum	d	d	1.3	2.0	2.0	4.5	No data	No data	No data	Not reported	No data	No data	No data	No data	No data	No data
Nitrate as N (ppm)																
Average	0.316	0.316	0.059	0.380	0.380	0.435	0.2	1.0	1.0	1.5	0.3	0.011	0.06	<.05	1.2	0.3
Flow-Weighted Average	0.376	0.377	0.099	0.510	0.510	0.589	b	b	b	b	b	0.013	b	b	b	b
Maximum	0.770	0.510	2.200	2.100	2.100	2.500	0.8	6.1	1.9	1.7	1.0	0.020	0.2	No data	6.1	2.1
Total Ammonia as N (ppm)																
Average	0.065	0.090	0.054	0.027	0.027	0.018	0.12	0.05	0.28	0.12	0.07	0.059	0.04	0.03	0.06	0.11
Flow-Weighted Average	0.069	0.088	0.038	0.025	0.025	0.020	b	b	b	b	b	0.067	b	b	b	b
Maximum	0.400	0.680	0.690	0.310	0.310	0.050	1.00	0.51	0.92	0.32	0.20	0.130	0.21	No data	0.14	1.00
Total Phosphorus (ppm)																
Average	0.030	0.030	0.059	0.070	0.070	0.107	0.137	0.161	0.340	0.120	0.061	0.044	0.030	0.04	0.085	0.057
Flow-Weighted Average	0.048	0.048	0.097	0.103	0.103	0.163	b	b	b	b	b	0.039	b	b	b	b
Maximum	0.081	0.300	0.570	0.609	0.609	0.718	1.53	1.612	0.740	0.270	0.650	0.090	4.400	No data	1.250	0.460

Table 3.3-3
Surface Water Quality Baseline Conditions for Southern Utah County and Eastern Juab County

Table 3.3-3
Surface Water Quality Baseline Conditions for Southern Utah County and Eastern Juab County

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Key Water Quality Parameters	Southern Utah County												Eastern Juab County			
	Sixth Water Creek			Diamond Fork Creek		Upper Spanish Fork River	Lower Spanish Fork River	Spring Creek	Beer Creek	Benjamin Slough	Lower Currant Creek					
	Strawberry Tunnel to Sixth Water Tunnel	Sixth Water Tunnel to Fifth Water Creek	Fifth Water Creek to Three Forks	Three Forks to Red Hollow[a]	Red Hollow to Spanish Fork River						Above Diversions	Below Diversions	Salt Creek	West Creek	Upper Currant Creek[a]	Mona Reservoir
Coliforms (counts)																
Total	No data	No data	No data	479	479	280	No data	No data	No data	6,207	1,500	No data	No data	No data	No data	No data
Fecal	No data	No data	No data	No data	No data	23	No data	No data	No data	242	300	No data	No data	No data	No data	No data
Total Suspended Solids (ppm)[e]																
Average	3	301	43	72	72	177						26				
Flow-Weighted Average	5	d	95	115	115	265						21				
Maximum	6	d	368	715	715	1,237						46				
Turbidity (NTUs)																
Average				103	105	249	64	37	26	29	20		41	No data	48	15
Flow-Weighted Average				b	b	b	b	b	b	b	b		b	b	b	b
Maximum				975	975	2,047	560	310	70	32	51		320	No data	835	84

[a]Burraston Ponds has similar water quality.
[b]Insufficient flow data to calculate flow-weighted averages.
[c]No summer temperatures available. Assumed to be the same as maximum temperature in Sixth Water Creek from Strawberry Tunnel to Sixth Water Creek.
[d]Only one sample available.
[e]Because turbidity measurements in NTUs were not available at all locations, data on the related parameter total suspended solids (TSS) are presented.

Table 3.3-3
Surface Water Quality Baseline Conditions for Southern Utah County and Eastern Juab County

There are also periodic baseline exceedences for the following key water quality parameters:

Phosphorus: Maximum total phosphorus concentrations in all surface water features exceed the standard. Maximum concentrations generally occur during peak spring runoff and snowmelt, when winter accumulations of phosphorus would be carried with suspended solids. High concentrations also occur when water from Strawberry Reservoir is released from below the thermocline during the irrigation season.

Salinity: Maximum salinity periodically exceeds the water quality standards for the lower Spanish Fork River, Beer Creek, Benjamin Slough, Salt Creek, and upper Currant Creek. Periodic exceedences for the lower Spanish Fork River, Beer Creek, Benjamin Slough, and Salt Creek occur during low flow periods, when flows are primarily comprised of relatively saline irrigation return flows and discharges from springs. Maximum salinity in upper Currant Creek occurs during high flow periods and is related to the flushing of salts that accumulated (particularly on the tributary West Creek) during the previous year. It is also noted that West Creek is not classified under the standards; however, baseline conditions would not meet the agricultural standard of 1,200 parts per million (ppm) of TDS.

Dissolved Oxygen: Minimum dissolved oxygen concentrations periodically do not meet the standard for Diamond Fork Creek, the upper and lower Spanish Fork River, Spring Creek, Beer Creek, lower Currant Creek above diversions, and Mona Reservoir. Low dissolved oxygen levels typically occur during periods of low flows (when there is limited aeration in the streams) and warm temperatures (which reduce the saturation level for oxygen).

Temperature: The maximum temperature standard is periodically exceeded in Sixth Water Creek, Diamond Fork Creek, the upper and lower Spanish Fork River, Beer Creek, lower Currant Creek, Salt Creek, and upper Currant Creek. While not covered under a standard, it is noted that the maximum temperature of 86°F in West Creek would exceed any of the state fishery standards. In Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River, these exceedences occur in the summer when releases from Strawberry Reservoir are made from above the thermocline. Maximum temperatures in other features generally occur during low flow periods in the summer.

Nitrate: The nitrate standard is periodically exceeded in Spring Creek and upper Currant Creek.

Ammonia: Maximum ammonia concentrations may exceed the 4-day average (chronic) temperature- and pH-dependant standard in Sixth Water Creek, Diamond Fork Creek, the upper and lower Spanish Fork River, and Mona Reservoir, if peak ammonia concentrations occur when peak temperatures and pH occur. All of the peak ammonia concentrations meet the 1-hour average (acute) standard.

Coliforms: The total coliforms count in Benjamin Slough (based on one sample) exceeds the standard. No data were available for upper Diamond Fork and Sixth Water Creeks.

Baseline conditions with respect to selenium, other trace elements, and pesticides are considered separately in Section 3.3.6.10.

Sedimentation studies (CUWCD 1997f) were limited to Sixth Water Creek and Diamond Fork Creek. The baseline operation of Strawberry Reservoir has resulted in dramatic changes in the character of these reaches. Since most of the sediment has been historically eroded from Sixth Water Creek, little sediment is gained until the flow discharges into Diamond Fork Creek. The load eventually becomes too much for the stream to carry and is deposited in the lower reaches of Diamond Fork Creek, which has become an unstable braided stream environment. The baseline sediment budget in the Diamond Fork drainage above the confluence with the Spanish Fork River is shown in Table 3.3-4.

Table 3.3-4 Baseline Sediment Budget		
Location	**Sediment Transport (tons/year)**	**Total Suspended Solids (ppm)**
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	7,800	98
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	7,800	98
Sixth Water Creek: Fifth Water Creek to Three Forks*	7,800	98
Diamond Fork Creek: Three Forks to Red Hollow	17,800	174
Diamond Fork Creek: Red Hollow to Spanish Fork River	26,500	217

*No analysis was conducted for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Tunnel to Fifth Water Creek.

3.3.5.2 Groundwater Quality

Baseline average groundwater salinity was estimated for southern Utah Valley and northern Juab Valley based on evaluation of the salt balance (i.e., the change in salt content based on fluctuations of salt inflows and outflows). The average salinity is about 413 ppm in southern Utah Valley and ranges from about 355 to 435 ppm. In northern Juab Valley, the salinity averages about 633 ppm and ranges from 595 to 675 ppm. The average salinity in Goshen Valley ranges from about 825 ppm at the margins of the valley to about 1,960 ppm near Utah Lake (Cordova 1970).

Salinity tends to increase from the margins of the valleys in the recharge (inflow) areas to the central portions of the valleys, where discharge (outflow) predominates. The increased salinity in the discharge areas would relate in part to the transpiration of water (but not salts) by plants that use groundwater, a process that tends to concentrate the salts.

3.3.6 Impact Analysis

The discussion below presents the impacts of the Proposed Action and alternatives on water quality. These impacts include consideration of the SFN System and related improvements to conveyance and application efficiencies of the local distribution and on-farm systems. This section is generally organized by alternative, except that Section 3.3.6.10 discusses contaminant impacts for all alternatives.

TDS, phosphorus, and temperature impacts were estimated using a quantitative mixing analysis for Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River. The analysis reflects that phosphorus concentrations and temperatures would vary, depending on whether releases would be made from above or below the thermocline in Strawberry Reservoir. The potential range of phosphorus and temperature impacts is defined by presenting two "end-points," which assume that all water would be either released from above or below the thermocline.

Because baseline temperatures were evaluated based on conditions before enlargement of Strawberry Reservoir (when it appears that releases were primarily from above the thermocline), the changes in temperature with the SFN System may be overstated because much of this impact relates to enlargement of Strawberry Reservoir rather than to operation of the SFN System. Similarly, the phosphorus concentrations above and below the thermocline

reflect concentrations before the enlargement of Strawberry Reservoir and do not include consideration of the reduction in phosphorus concentrations anticipated in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) (i.e., the pre-enlargement concentrations of 0.030 ppm above the thermocline and 0.157 ppm below the thermocline would be reduced to 0.021 ppm and 0.095 ppm, respectively). The phosphorus concentrations also reflect conditions that existed prior to the 20-year phosphorus reduction program begun in 1984.

The impact tables present the estimated worst cases for ammonia. Although baseline ammonia decreases downstream are partially attributable to aeration, no attempt was made to correlate increased future flows to reduced ammonia. Although no measurable changes in ammonia are estimated for any of the locations, lowering the water temperature in some locations could mitigate some baseline ammonia exceedences of standards.

3.3.6.1 Significance Criteria

Water quality impacts are considered significant if water quality standards (shown previously in Table 3.3-1) that are currently met would be exceeded. The standard for turbidity (in which changes in turbidity should be less than 10 NTUs) strictly applies to point sources of turbidity and is generally not applicable to the nonpoint changes expected for the Proposed Action and alternatives. For the purpose of this report, changes in turbidity are addressed as unquantified increases or decreases based on the assumption that changes in turbidity are directly related to changes in flow and all such changes are assumed to be significant. The significance of water quality impacts with respect to related resource areas will be evaluated in the sections that deal with these related resources.

3.3.6.2 Potential Impacts Eliminated from Further Analysis

The SFN System would not have a measurable impact on water quality in Utah Lake. However, the potential cumulative impacts to Utah Lake as a result of the completion of the Bonneville Unit are described in Section 2.3.4.

3.3.6.3 Proposed Action

3.3.6.3.1 Surface Water Quality. The average and maximum (except dissolved oxygen, which considers minimums) water quality conditions of affected water features by the key water quality parameters that would likely occur as a result of the Proposed Action are presented in Table 3.3-5. Potential impacts to water quality from construction and operation activities are discussed below and are summarized in Section 3.3.6.11.

3.3.6.3.1.1 Construction Impacts. Construction impacts to surface water quality could result from activities that disturb the soil, accidental spills of fuels or other liquids, or instream activities that would affect the hydraulics of river and stream crossings.

Construction upstream of Monks Hollow for the "Diamond Fork Tunnel Alternative" would include the Sixth Water Siphon, Tanner Ridge Tunnel, Diamond Fork Siphon, and Red Mountain Tunnel, which would have minor impacts on water quality. The portals for Tanner Ridge Tunnel and Red Mountain Tunnel would be located far enough from the creek to not directly impact the flows or water quality with the use of proper construction precautions as described in Section 1.6.6.9. Construction of the Sixth Water Siphon and Diamond Fork Siphon would require short-term diversion of streamflows and produce increased turbidity when the diverted flow is returned to the channel.

Construction of the Proposed Action would not cause significant impacts on surface water quality at other locations for the following reasons:

- Construction activities with a potential for disturbing stream channels, riparian areas, and floodplains would be performed in accordance with *Nonpoint Source Water Pollution Control Plan for Hydrology Modifications in Utah* (Plan) (Robinson 1994). These practices are designated as the State of Utah's Best Management Practices for nonpoint source water pollution control and are included as Standard Operating Procedures (see Appendix B, *Standard Operating Procedures*).

- Spill containment and countermeasure requirements would be included in CUWCD's construction specifications, which would minimize the potential for adverse impacts of a spill.

- Construction activities would be minimized in riparian stream crossings and seep and spring areas during periods of unstable soil and stream bank conditions caused by high soil moisture, snowmelt runoff, or extended periods of rain. This would improve the effectiveness of management measures to minimize the impacts of construction activities and accidental spills.

3.3.6.3.1.2 Operation Impacts. Operation of the Proposed Action could affect water quality in various surface water and groundwater features, as discussed below.

In Sixth Water Creek, Diamond Fork Creek, and the upper Spanish Fork River, the average and maximum salinity under the Proposed Action would generally increase from about 40 to 80 ppm TDS, resulting from conveyance of relatively low salinity Strawberry Reservoir water in the "Diamond Fork Tunnel Alternative" and Diamond Fork Pipeline instead of in the creeks and rivers. Most natural flow has higher salinity than the water released from Strawberry Reservoir. Fifth Water Creek and Cottonwood Creek are particularly saline. Average salinity increases and maximum salinity increases would result in TDS levels that remain within State standards.

Flows would be substantially decreased during the irrigation season and slightly increased during low flow months, and these flow changes would impact turbidity. Reduction of peak flows would reduce erosion. While the increase of minimum flows to about 25 cfs in Sixth Water Creek would slightly increase erosion, this increased erosion could be offset by decreasing the number of stagnant pools that enhance algal growth. Slight increases in flow in the lower Spanish Fork River might cause slight increases in turbidity. The related downstream impacts on sedimentation resulting from the Proposed Action are discussed in Section 3.3.6.3.3.

Flow changes would also impact dissolved oxygen and ammonia concentrations. Increased flows in low-flow months would increase aeration, resulting in increased minimum dissolved oxygen levels. In addition, reductions in peak temperatures would also tend to increase the minimum dissolved oxygen concentrations. Substandard baseline minimum dissolved oxygen levels may be mitigated. Ammonia dissipation might be enhanced, but not to the extent that measurable impacts are expected. In addition, lower temperatures discussed below would make ammonia less of a critical parameter; the impact has not been quantified.

Impacts of the Proposed Action on phosphorus and temperature would largely depend on whether releases from Strawberry Reservoir would be made from above or below the thermocline, which in turn would depend on the elevation of Strawberry Reservoir. As previously estimated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990, table 19, pg 61), releases for about 35 to 55 percent of the years would be entirely from below the thermocline, 25 to 40 percent would be from entirely above the thermocline, and 10 to 25 percent would be from both above and below the thermocline.

Phosphorus would vary depending on the timing of spring runoff and snowmelt and on whether Strawberry Reservoir releases would be made from above or below the thermocline. Releases from above the thermocline would reduce phosphorus, mitigating baseline exceedence of standards above Fifth Water Creek, but standards would still be exceeded below Fifth Water Creek. Releases from below the thermocline would generally increase average phosphorus concentrations and reduce maximum phosphorus concentrations. The decreases in maximum phosphorus would not be enough to mitigate exceedences.

Table 3.3-5
Water Quality Resulting from the Proposed Action

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Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Average Water Quality														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+53	nm	nm	-8	-16	nm	nm	nm	-0.041	+0.106	nm	nm	D
	Value	236	8.1	7.3	51	43	3.2	0.376	0.069	0.007	0.154	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	+41	nm	nm	-8	-16	nm	nm	nm	-0.040	+0.106	nm	nm	D
	Value	237	8.1	NQ	51	43	2.4	0.377	0.088	0.008	0.154	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	+54	nm	nm	-7	-14	nm	nm	nm	+0.005	+0.126	nm	nm	D
	Value	276	8.2	9.4	51	44	1.2	0.099	0.038	0.102	0.223	NQ	NQ	NQ
Diamond Fork Creek: Three Forks to Red Hollow	Change	+76	nm	nm	-6	-10	nm	nm	nm	-0.006	+0.080	nm	nm	D
	Value	289	8.1	7.0	51	47	1.6	0.510	0.025	0.097	0.183	NQ	NQ	NQ
Diamond Fork Creek: Below Red Hollow	Change	+54	nm	nm	-5	-12	nm	nm	nm	-0.034	+0.072	nm	nm	D
	Value	267	8.1	7.0	52	45	1.6	0.510	0.025	0.069	0.175	479	NQ	NQ
Upper Spanish Fork River	Change	+29	nm	nm	-4	-7	nm	nm	nm	+0.009	+0.058	nm	nm	D
	Value	330	8.2	8.0	53	50	3.0	0.589	0.020	0.172	0.221	280	23	NQ
Lower Spanish Fork River	Change	D	nm	nm	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	NQ	8.1	8.5	NQ	NQ	NQ	0.220	0.120	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	+26	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	554	8.2	9.2	48	48	NQ	1.000	0.050	0.161	0.161	NQ	NQ	37
Beer Creek	Change	+40	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	835	7.9	8.1	54	54	NQ	1.000	0.280	0.340	0.340	NQ	NQ	26
Benjamin Slough	Change	+50	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,048	8.4	12.9	57	57	3.0	1.500	0.120	0.120	0.120	6,207	242	29
Lower Currant Creek Below Mona Reservoir	Change	-77	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	889	8.2	9.1	59	59	NQ	0.3	0.07	NQ	NQ	1,500	300	NQ
Lower Currant Creek Below Diversions	Change	-73	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	835	8.4	8.0	63	63	NQ	0.067	0.050	NQ	NQ	NQ	NQ	NQ
Salt Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	D	D	nm	nm	D
	Value	610	8.3	9.2	48	48	NQ	0.06	0.04	NQ	NQ	NQ	NQ	NQ
West Creek	Change	+250	nm	nm	nm	nm	nm	nm	nm	1	I	nm	nm	I
	Value	2,521	8.8	14.0	73	73	NQ	<0.05	0.03	NQ	NQ	NQ	NQ	NQ
Upper Currant Creek	Change	+107	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	1.084	8.1	9.3	57	57	NQ	1.2	0.06	NQ	NQ	NQ	NQ	NQ
Mona Reservoir	Change	-70	nm	1	D	D	nm	nm	nm	I	I	nm	nm	1
	Value	794	8.3	NQ	NQ	NQ	NQ	0.3	0.11	NQ	NQ	NQ	NQ	NQ

Table 3.3-5
Water Quality Resulting from the Proposed Action

Table 3.3-5
Water Quality Resulting from the Proposed Action

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Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Maximum Levels														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+21	nm	nm	nm	-20	nm	nm	nm	-0.044	+0.076	nm	nm	D
	Value	295	8.6	7.0	67	47	3.2	0.770	0.400	0.037	0.157	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	+1	nm	I	nm	-23	nm	nm	nm	-0.261	-0.143	nm	nm	D
	Value	295	8.5	NQ	67	47	2.4	0.510	0.680	0.039	0.157	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	-116	nm	I	-3	-21	nm	nm	nm	-0.133	-0.013	nm	nm	D
	Value	316	8.6	NQ	67	49	1.3	2.200	0.690	0.437	0.557	NQ	NQ	NQ
Diamond Fork Creek: Three Forks to Red Hollow	Change	-61	nm	I	-1	-15	nm	nm	nm	-0.308	-0.229	nm	nm	D
	Value	322	8.6	NQ	69	55	2.0	2.100	0.310	0.301	0.380	NQ	NQ	NQ
Diamond Fork Creek: Below Red Hollow	Change	-69	nm	I	-3	-20	nm	nm	nm	-0.408	-0.304	nm	nm	D
	Value	314	8.6	NQ	67	50	2.0	2.100	0.310	0.201	0.305	NQ	NQ	NQ
Upper Spanish Fork River	Change	-61	nm	1	-9	-19	nm	nm	nm	-0.308	-0.285	nm	nm	D
	Value	428	8.5	NQ	66	56	4.5	2.500	0.050	0.410	0.433	NQ	NQ	NQ
Lower Spanish Fork River	Change	nm	nm	nm	nm	nm	nm	nm	nm	I	1	nm	nm	I
	Value	1,260	9.0	0.03	84	84	NQ	0.800	1.000	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	+56	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,172	8.6	4.7	77	77	NQ	6.100	0.510	1.612	1.612	NQ	NQ	310
Beer Creek	Change	+78	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,638	8.6	1.9	82	82	NQ	1.900	0.920	0.740	0.740	NQ	NQ	70
Benjamin Slough	Change	+81	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,695	8.5	8.8	75	75	NQ	1.700	0.320	0.270	0.270	NQ	NQ	32
Lower Currant Creek Below Mona Reservoir	Change	-92	nm	1	D	D	nm	nm	nm	I	1	nm	nm	1
	Value	1,060	8.6	NQ	NQ	NQ	NQ	0.990	0.200	NQ	NQ	NQ	NQ	NQ
Lower Currant Creek Below Diversions	Change	-83	nm	I	D	D	nm	nm	nm	1	I	nm	nm	1
	Value	957	9.0	NQ	NQ	NQ	NQ	0.130	0.070	NQ	NQ	NQ	NQ	NQ
Salt Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	D	D	nm	nm	D
	Value	5,470	8.5	6.7	70	70	NQ	0.210	0.210	NQ	NQ	NQ	NQ	NQ
West Creek	Change	+1,144	nm	I	D	D	nm	nm	nm	1	1	nm	nm	1
	Value	11,544	9.5	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Upper Currant Creek	Change	nm	nm	nm	D	D	nm	nm	nm	I	I	nm	nm	1
	Value	3,500	8.7	7.3	NQ	NQ	NQ	6.100	0.140	NQ	NQ	NQ	NQ	NQ
Mona Reservoir	Change	-110	nm	nm	nm	nm	nm	nm	nm	1	1	nm	NQ	I
	Value	1,010	8.9	3.5	73	73	NQ	2.100	1.000	NQ	NQ	NQ	NQ	NQ

*For Strawberry Reservoir releases from above or below the thermocline. Changes in average temperature and phosphorus are based on comparison to historical temperatures, which include a mix of water from above and below the thermocline. Temperatures and phosphorus in the lower Spanish Fork River, Spring Creek, Beer Creek, Benjamin Slough, upper and lower Currant Creek, Salt Creek, West Creek, and Mona Reservoir are not dependent on Strawberry Reservoir releases.
Codes: nm = No measurable change; D = Unquantified decrease; 1 = Unquantified increase; NQ = Not quantified.

Table 3.3-5
Water Quality Resulting from the Proposed Action

Temperatures would vary depending on whether releases from Strawberry Reservoir are made from the relatively warm water above the thermocline or the relatively cool water below the thermocline. Because the outlet from Strawberry Reservoir releases water from a single elevation, water cannot be selectively released from above or below the thermocline. In addition to the flow-weighted average annual temperatures shown in Table 3.3-5, estimated monthly temperatures for the releases made from above and below the thermocline as a result of the Proposed Action are presented in Table 3.3-6. Both average and maximum temperatures would be reduced with the Proposed Action.

Table 3.3-6
Monthly Average Temperatures in Sixth Water Creek, Diamond Fork Creek, and the Upper Spanish Fork River Resulting from the Proposed Action

Month	Strawberry Reservoir Releases Made from Above the Thermocline			Strawberry Reservoir Releases Made from Below the Thermocline		
	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River (°F)	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River (°F)
May	49	50	56	43 to 46	47	55
June	60 to 61	61	60	45 to 48	49 to 53	55
July	67	67 to 69	66	47 to 49	49 to 55	55
August	66	67 to 69	65	47 to 49	50 to 54	56
September	63	63 to 65	62	46 to 48	49 to 52	54

*Based on results presented in the *Hydrology and Water Resources Technical Report* (CUWCD 1998b)

The Proposed Action would not cause measurable changes to ammonia, pH, BOD, nitrate, or coliforms. The pH would not be measurably changed because of the similarity of the pH of the various source waters and the buffering in the system that limit pH changes. BOD, nitrate, coliforms, and ammonia would not be measurably impacted because the additional water from Strawberry Reservoir is similar to other source waters, and the Proposed Action would not result in additional sources of these key parameters.

The Proposed Action would result in an average increase in salinity of about 5 percent in Spring Creek, Beer Creek, and Benjamin Slough. The average salinity in these features would increase about 26 to 50 ppm of TDS, and the salinity would remain within the water quality standard for all of the features. The maximum salinity in these features would increase about 56 to 81 ppm of TDS, and the maximum salinity would continue to exceed the water quality standard in Beer Creek and Benjamin Slough and would remain within the standard in Spring Creek. These impacts result from increases in the salinity of spring discharges, discussed more fully in Section 3.3.6.3.2.

The increased flows in Spring Creek, Beer Creek, and Benjamin Slough (about 7 percent on average as discussed in Section 3.2.6.3.2.2) would not be large enough to cause measurable changes in water quality parameters that depend on flow. Also, effects on pH, temperatures, BOD, nitrate, ammonia, and coliforms would not be measurable.

In eastern Juab County, the Proposed Action would result in an increase of about 11 percent in the salinity of springflows, which would cause a similar increase in the salinity in West Creek, upper Currant Creek, and Burraston Ponds. Increased discharges from springs would increase the amount of water flowing into West Creek, upper Currant Creek, and Burraston Ponds by about 55 to 60 percent; this increase in flow could increase the turbidity and minimum dissolved oxygen levels and reduce maximum temperatures. Effects on pH, temperatures, BOD, nitrate, ammonia, and coliforms would not be measurable.

Water quality changes in Mona Reservoir would result from changes in the quality of inflows from springs and upper Currant Creek and the direct delivery of water from the SFN System. The Proposed Action would reduce salinity in Mona Reservoir. This reduction occurs because the improvement in salinity resulting from the direct delivery of relatively low salinity water from the SFN System is greater than the degradation in salinity resulting from the increased salinity of inflows from springs and upper Currant Creek. Turbidity and total phosphorus concentrations could increase in Mona Reservoir because of the greater volume of water and turbulence in the reservoir, resulting in greater suspended solids. Effects on pH, BOD, nitrate, ammonia, and coliforms would not be measurable.

Water quality changes in lower Currant Creek would reflect both changes in the quality of inflow from Mona Reservoir and the changes in flow. The salinity in lower Currant Creek would decline, reflecting reduced salinity of waters derived from Mona Reservoir. The greater average and maximum flows in lower Currant Creek would increase its turbidity and total phosphorus concentrations. The greater flows could also result in an increase in minimum dissolved oxygen because of improved aeration, a possible reduction in the peak temperature through the possible lowering of the average temperature in Mona Reservoir, and a possible elimination of relatively stagnant pools that would have warmer temperatures. The effects on pH, BOD, nitrate, ammonia, and coliforms would not be measurable.

3.3.6.3.2 Groundwater Quality. Groundwater quality impacts are considered under the two major categories of construction impacts and operation impacts.

3.3.6.3.2.1 Construction Impacts. Construction impacts on groundwater quality could be caused by accidental releases of fuels or other liquids. The potential for adverse impacts from spills would be minimized through spill containment and countermeasure requirements of the CUWCD's construction specifications.

3.3.6.3.2.2 Operation Impacts. The operation of the Proposed Action in southern Utah Valley would result in an average groundwater salinity over the analysis period of about 445 ppm of TDS, or an increase of about 5 percent from the average baseline. This increase in salinity would result from the additional salts contained in the imported water, combined with a small increase in groundwater storage. The greater amount of salts contained in approximately the same water volume as for baseline would result in an increased concentration of salts.

In the Goshen Valley portion of southern Utah Valley, changes in salinity would not be expected to be measurable because the magnitude of the increase in inflow to groundwater (1,300 acre-feet) would be small relative to the current inflow to groundwater (36,800 acre-feet). In addition, the quality of this recharge water would be similar to the existing quality (with the salinity of recharge water derived from lower Currant Creek being slightly reduced from the baseline salinity).

In the northern Juab Valley area of eastern Juab County, the Proposed Action would result in an increase of about 11 percent in the average groundwater salinity. The salinity increase would build up over the initial years of project operation and stabilize at an increase of about 14 percent (or 90 ppm) by the end of the period. The salinity increase would result primarily from the additional salt loading from leaching of salts from lands currently developed for agriculture but not irrigated.

The processes of irrigation and percolation of irrigation return flows would tend to increase dissolved oxygen and reduce BOD and could result in additional denitrification (conversion of nitrate to ammonium by oxidation), which reduces toxic forms of nitrogen. Temperatures would tend to equilibrate with the existing groundwater temperature.

3.3.6.3.3 Sedimentation. Sediment transport for Diamond Fork and Sixth Water Creeks was the subject of a recent study by the CUWCD (CUWCD 1997b). Water from Strawberry Reservoir has been conveyed through Sixth Water and Diamond Fork Creeks since 1915. Historical releases from Strawberry Reservoir have

dramatically changed the character of the channel and its sediment load. Sampling of suspended sediment has been conducted on Diamond Fork Creek below Red Hollow and on Sixth Water Creek below Sixth Water Tunnel. Mean monthly sediment loads were calculated for two data sets, one representing channel conditions when Strawberry Tunnel was discharging and the other when it was not. These data were then used to estimate sediment impacts at selected locations based on a regression analysis relating sediment budget to flow conditions.

Estimates of the tons of sediment that would be transported as bed load and suspended sediment through each reach are presented for the Proposed Action, in addition to the resulting concentration of total suspended solids in ppm. In all reaches, less sediment would be transported compared to baseline conditions, and in general, there would be an associated reduction in concentration. The exception would be Diamond Fork Creek between Three Forks and Red Hollow, where a reduction in tons of sediment transported below Red Hollow would be associated with a small increase in concentration. The sediment budget and impacts for Diamond Fork and Sixth Water Creeks are shown in Table 3.3-7.

Table 3.3-7
Sediment Budget and Impacts Resulting from the Proposed Action

Location		Sediment Transport (tons/year)	Concentration (ppm)	Impacts
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change[a]	-6,500	-58	Decreased bank erosion; preservation of natural sediment accretions; bank stabilization; vegetation establishment.
	Value[b]	1,300	40	
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change[a]	-6,500	-58	Reduced sediment loading and gradual stabilization as described for the previous reach.
	Value[b]	1,300	40	
Sixth Water Creek: Fifth Water Creek to Three Forks[c]	Change[a]	-6,500	-58	Reduced sediment loading and gradual stabilization as described for the previous reach.
	Value[b]	1,300	40	
Diamond Fork Creek: Three Forks to Red Hollow	Change[a]	-6,500	+24	Reduced sediment loading.
	Value[b]	11,300	198	
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change[a]	-6,500	-18	Decreased bank erosion; gradual narrowing of channel; braided sections would become more stable and develop a single, dominant channel.
	Value[b]	20,000	199	

[a]Changes are based on the relative reduction from baseline conditions and are generally valid for either monthly or daily flows.
[b]Tons per year of sediment transportation based on the application of the prediction equation to monthly flows. This underestimates the sediment transported based on daily flows by about 10 to 15 percent.
[c]No analysis was conducted for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Tunnel to Fifth Water Creek.

Existing channels have already adjusted to high flows from Strawberry Reservoir historic releases. With proposed changes in operations, both channels would undergo a period of adjustment to the new flows. Qualitative estimates have been made of the impacts for the channels of Diamond Fork and Sixth Water Creeks under the Proposed Action (CUWCD 1997b).

3.3.6.3.4 Mitigation. No water quality mitigation would be required for the Proposed Action.

3.3.6.3.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts would occur as a result of the Proposed Action at some locations with respect to TDS, phosphorus, and turbidity. Average and peak TDS concentrations at most locations would increase, but not significantly. Phosphorus concentrations would also increase at many locations and would increase significantly in Sixth Water Creek between Strawberry Tunnel and Fifth Water Creek when releases are made from below the thermocline at Strawberry Reservoir. Significant increases in turbidity would occur in the lower Spanish Fork River, lower Currant Creek (both above and below diversions), West Creek, upper Currant Creek, and Mona Reservoir.

3.3.6.4 MCAPW-DFT Alternative

Construction and sedimentation impacts on water quality resulting from the MCAPW-DFT Alternative would be the same as those described previously for the Proposed Action. Operation impacts would be the same as those previously described for the Proposed Action, except in the upper Spanish Fork River. The water quality impacts in the upper Spanish Fork River differ from those of the Proposed Action because in the MCAPW-DFT Alternative, SVP water is conveyed in the upper Spanish Fork River rather than in the Main Conveyance Aqueduct. Potential impacts to water quality from construction and operation are summarized in Section 3.3.6.11. Discussion in this section is limited to operation impacts in the upper Spanish Fork River.

3.3.6.4.1 Surface Water Quality. Changes in water quality in the upper Spanish Fork River would be the same as those discussed in Section 3.3.6.2 for the Proposed Action, except for salinity, phosphorus, temperature, and turbidity. Under the MCAPW-DFT Alternative, water from Strawberry Reservoir would constitute a greater proportion of the flow in upper Spanish Fork River than under baseline conditions, which would result in an average salinity of 283 ppm (a reduction of 18 ppm from baseline), and a maximum salinity of 404 ppm (a reduction of 85 ppm from baseline). The greater proportion of Strawberry Reservoir water would also impact phosphorus concentrations and temperatures, with this impact depending on whether releases are made from above or below the thermocline. When releases are made from above the thermocline, the MCAPW-DFT Alternative would result in an average phosphorus concentration of about 0.133 ppm (a reduction of about 0.030 ppm), a peak phosphorus concentration of about 0.395 ppm (a reduction of about 0.323 ppm), an average temperature of 55°F (a decrease of 2°F), and a maximum temperature of 65°F (a decrease of 10°F). When releases are made from below the thermocline, the average phosphorus concentration would be about 0.194 ppm (an increase of about 0.031 ppm), the peak concentration would be about 0.423 ppm (a reduction of about 0.295 ppm), an average temperature of 50°F (a decrease of 7°F), and a maximum temperature of 54°F (a decrease of 21°F). The greater average and peak flows would result in increases in turbidity over the baseline average of 249 nephelometric turbidity units (NTUs) and baseline peak of 2,047 NTUs.

3.3.6.4.2 Mitigation. No water quality mitigation would be required under the MCAPW-DFT Alternative.

3.3.6.4.3 Unavoidable Adverse Impacts. The unavoidable adverse impacts would generally be the same as those discussed for the Proposed Action. However, impacts would differ from the Proposed Action in that a significant increase in turbidity in the upper Spanish Fork River would occur under the MCAPW-DFT Alternative.

3.3.6.5 MCAP Alternative

Impacts to the quality of surface water and groundwater would occur as a result of the MCAP Alternative. These impacts would differ from the Proposed Action in the southern Utah Valley portion of southern Utah County and would be the same as the Proposed Action in eastern Juab Valley and in the Goshen Valley area of southern Utah County. For ease of reference, this section discusses all of the water quality impacts resulting from the MCAP Alternative (not only those that differ from the Proposed Action).

3.3.6.5.1 Surface Water Quality. The average and maximum (except dissolved oxygen, which considers minimums) water quality conditions of affected water features that would likely occur as a result of the MCAP

Alternative are presented by key water quality parameter in Table 3.3-8. Potential impacts to water quality from construction and operation activities are discussed below and are summarized in Section 3.3.6.11.

3.3.6.5.1.1 Construction Impacts. Construction impacts to surface water quality could result from activities that disturb the soil, accidental spills of fuels or other liquids, or instream activities that would affect the hydraulics of river and stream crossings. The MCAP Alternative would not cause significant impacts on surface water quality for the following reasons:

- Construction activities with a potential for disturbing stream channels, riparian areas, and floodplains would be performed in accordance with *Nonpoint Source Water Pollution Control Plan for Hydrology Modifications in Utah* (Plan) (Robinson 1994). These practices are designated as the State of Utah's Best Management Practices for nonpoint source water pollution control and are included as Standard Operating Procedures (see Appendix B, *Standard Operating Procedures*).

- Spill containment and countermeasure requirements would be included in CUWCD's construction specifications, which would minimize the potential for adverse impacts of a spill.

- Construction activities would be minimized in riparian stream crossings and seep and spring areas during periods of unstable soil and stream bank conditions caused by high soil moisture, snowmelt runoff, or extended periods of rain. This would improve the effectiveness of management measures to minimize the impacts of construction activities and accidental spills.

3.3.6.5.1.2 Operation Impacts. The average TDS concentration of flows in Sixth Water Creek, Diamond Fork Creek, and the Spanish Fork River would be similar to baseline, with the impact ranging from an increase of about 54 ppm (in Sixth Water Creek above Sixth Water Tunnel) to a reduction of about 23 ppm (in Sixth Water Creek below Fifth Water Creek). These impacts reflect both the impacts of the additional water from Strawberry Reservoir and changes in flows in each month that affect the flow-weighted averages. Peak TDS concentrations would be reduced, reflecting releases of relatively low TDS Strawberry Reservoir water during low flow periods to maintain minimum flows.

Average annual and peak flows from Sixth Water Creek below Sixth Water Tunnel to Diamond Fork Creek above Red Hollow and in the lower Spanish Fork River would increase as a result of conveyance of water under the MCAP Alternative. These increased flows would result in increased turbidity. Flow would be reduced in Diamond Fork Creek below Red Hollow and in the upper Spanish Fork River, because of the conveyance of water in the Diamond Fork Pipeline and the Main Conveyance Aqueduct, resulting in reduced turbidity for these features. The increased minimum flows would also increase aeration, resulting in increased minimum dissolved oxygen levels.

Phosphorus concentrations would depend on whether Strawberry Reservoir releases would be made from above or below the thermocline. Releases from above the thermocline would result in reduced average phosphorus concentrations in Sixth Water Creek, Diamond Fork Creek, and the Spanish Fork River, while releases from below the thermocline would result in increased average phosphorus concentrations. Maximum phosphorus concentrations would decrease from Sixth Water Creek below Sixth Water Tunnel to the upper Spanish Fork River, because relatively high phosphorus concentrations during low flow periods would be diluted by the minimum flows.

Temperatures would vary, depending on whether releases from Strawberry Reservoir are made from the relatively warm water above the thermocline or the relatively cool water below the thermocline. Because the outlet from Strawberry Reservoir releases water from a single elevation, water cannot be selectively released from above or below the thermocline. In addition to the flow-weighted average temperatures shown in Table 3.3-8, estimated monthly temperatures for the releases made from above and below the thermocline as a result of the MCAP

Alternative are presented in Table 3.3-9. As estimated previously in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990, Table 19, pg 61), releases would be made entirely from above the thermocline in 35 to 55 percent of the years, entirely from below the thermocline in 25 to 40 percent of the years, and from both above and below the thermocline (during different parts of the year) in 10 to 25 percent of the years. Both average and maximum temperatures would be reduced with the MCAP Alternative.

Table 3.3-9
Monthly Average Temperatures in Diamond Fork Creek and the Upper Spanish Fork River Resulting from the MCAP Alternative

Month	Strawberry Reservoir Releases Made from Above the Thermocline			Strawberry Reservoir Releases Made from Below the Thermocline		
	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River* (°F)	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River* (°F)
May	49 to 50	51	57	41 to 43	45	55
June	61	63	61	42 to 46	46	53
July	65 to 67	69	68	44 to 47	48	52
August	65 to 66	68	65	45 to 47	48	55
September	62 to 63	64	63	45 to 46	48	53

*Assumes 3°F to 4°F warming from Diamond Fork Creek to the upper Spanish Fork River.

The MCAP Alternative would not cause measurable changes to ammonia, pH, BOD, nitrate, or coliforms. The pH would not be measurably changed because of the similarity of the pH of the various source waters and the buffering in the system that limit pH changes. BOD, nitrate, coliforms, and ammonia would not be measurably impacted because the additional water from Strawberry Reservoir is similar to other source waters, and the MCAP Alternative would not result in additional sources of these key parameters.

Changes in the groundwater salt balance and the resulting changes in the salinity of spring discharges (discussed more fully in Section 3.2.6.3.2) could result in changes in the salinity of surface water features fed by these springs. Changes in the quantity of springflows could also affect water quality in surface water features fed by springs because some water quality parameters (such as turbidity) vary in relation to flow.

In southern Utah Valley, the average salinity of spring discharges would be essentially unchanged from the baseline salinity, and the increase in the flow (about 17 percent as discussed in Section 3.2.6.3.3) would not be large enough to cause measurable changes in water quality parameters that depend on flow. Also, effects on pH, temperatures, BOD, nitrate, ammonia, and coliforms would not be measurable. Therefore, the MCAP Alternative would not result in measurable changes in the quality of the spring-fed features in southern Utah County (specifically, Spring Creek, Beer Creek, and Benjamin Slough).

In eastern Juab County, the MCAP Alternative would result in an increase of about 11 percent in the salinity of springflows, which would cause a similar increase in the salinity in West Creek, upper Currant Creek, and Burraston Ponds. Increased discharges from springs would increase the amount of water flowing into West Creek, upper Currant Creek, and Burraston Ponds by about 55 to 60 percent; this increase in flow could increase the turbidity and minimum dissolved oxygen levels and reduce maximum temperatures. Effects on pH, temperatures, BOD, nitrate, ammonia, and coliforms would not be measurable.

Table 3.3-8
Water Quality Resulting from the MCAP Alternative

Page 1 of 2

Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Average Water Quality														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+54	nm	nm	-8	-16	nm	nm	nm	-0.041	+0.105	nm	nm	D
	Value	237	8.1	7.3	51	43	3.2	0.376	0.069	0.007	0.153	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	-4	nm	nm	-1	-16	nm	nm	nm	-0.044	+0.108	nm	nm	I
	Value	192	8.1	NQ	58	43	2.4	0.377	0.088	0.004	0.156	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	-23	nm	nm	0	-15	nm	nm	nm	-0.077	+0.071	nm	nm	I
	Value	199	8.2	9.4	58	43	1.2	0.099	0.038	0.020	0.168	NQ	NQ	NQ
Diamond Fork Creek: Three Forks to Red Hollow	Change	-6	nm	nm	+3	-11	nm	nm	nm	-0.079	+0.060	nm	nm	I
	Value	207	8.1	7.0	60	46	1.6	0.510	0.025	0.024	0.163	NQ	NQ	NQ
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change	+18	nm	nm	-2	-11	nm	nm	nm	-0.081	+0.054	nm	nm	D
	Value	231	8.1	7.0	55	46	1.6	0.510	0.025	0.022	0.157	479	NQ	NQ
Upper Spanish Fork River	Change	+12	nm	nm	-2	-8	nm	nm	nm	-0.012	+0.049	nm	nm	D
	Value	313	8.2	8.0	55	49	3.0	0.589	0.020	0.151	0.212	280	23	NQ
Lower Spanish Fork River	Change	D	nm	nm	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	NQ	8.1	8.5	NQ	NQ	NQ	0.220	0.120	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	528	8.2	9.2	48	48	NQ	1.000	0.050	0.161	0.161	NQ	NQ	37
Beer Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	795	7.9	8.1	54	57	NQ	1.000	0.280	0.340	0.340	NQ	NQ	26
Benjamin Slough	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	998	8.4	12.9	57	57	3.0	1.500	0.120	0.120	0.120	6,207	242	29
Lower Currant Creek Below Mona Reservoir	Change	-77	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	889	8.2	9.1	59	59	NQ	0.3	0.07	NQ	NQ	1,500	300	NQ
Lower Currant Creek Below Diversions	Change	-73	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	835	8.4	8.0	63	63	NQ	0.067	0.050	NQ	NQ	NQ	NQ	NQ
Salt Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	D	D	nm	nm	D
	Value	610	8.3	9.2	48	48	NQ	0.06	0.04	NQ	NQ	NQ	NQ	NQ
West Creek	Change	+250	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	2,521	8.8	14.0	73	73	NQ	<0.05	0.03	NQ	NQ	NQ	NQ	NQ
Upper Currant Creek	Change	+107	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	1,084	8.1	9.3	57	57	NQ	1.2	0.06	NQ	NQ	NQ	NQ	NQ
Mona Reservoir	Change	-70	nm	I	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	794	8.3	NQ	NQ	NQ	NQ	0.3	0.11	NQ	NQ	NQ	NQ	NQ

Table 3.3-8
Water Quality Resulting from the MCAP Alternative

Table 3.3-8
Water Quality Resulting from the MCAP Alternative

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Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Maximum* Levels														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+21	nm	1	0	-20	nm	nm	nm	+0.286	+0.076	nm	nm	D
	Value	295	8.6	NQ	67	47	3.2	0.770	0.400	0.367	0.157	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	0	nm	I	-2	-22	nm	nm	nm	-0.290	-0.143	nm	nm	1
	Value	294	8.5	NQ	65	45	2.4	0.510	0.680	0.010	0.157	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	-125	nm	nm	-5	-25	nm	nm	nm	-0.488	-0.358	nm	nm	1
	Value	307	8.6	8.8	65	45	1.3	2.200	0.690	0.082	0.212	NQ	NQ	NQ
Diamond Fork Creek: Three Forks to Red Hollow	Change	-71	nm	1	-1	-22	nm	nm	nm	-0.494	-0.398	nm	nm	1
	Value	312	8.6	NQ	69	48	2.0	2.100	0.310	0.115	0.211	NQ	NQ	NQ
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change	-71	nm	I	-1	-22	nm	nm	nm	-0.494	-0.398	nm	nm	D
	Value	312	8.6	NQ	69	48	2.0	2.100	0.310	0.115	0.211	NQ	NQ	NQ
Upper Spanish Fork River	Change	-62	nm	I	-7	-20	nm	nm	nm	-0.292	-0.268	nm	nm	D
	Value	427	8.5	NQ	68	55	4.5	2.500	0.050	0.426	0.450	NQ	NQ	NQ
Lower Spanish Fork River	Change	nm	nm	I	nm	nm	nm	nm	nm	I	1	nm	nm	I
	Value	1,260	9.0	NQ	84	84	NQ	0.800	1.000	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,116	8.6	4.7	77	77	NQ	6.100	0.510	1.612	1.612	NQ	NQ	310
Beer Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,560	8.6	1.9	82	82	NQ	1.900	0.920	0.740	0.740	NQ	NQ	70
Benjamin Slough	Change	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,614	8.5	8.8	75	75	NQ	1.700	0.320	0.270	0.270	NQ	NQ	32
Lower Currant Creek Below Mona Reservoir	Change	-92	nm	I	D	D	nm	nm	nm	I	1	nm	nm	1
	Value	1,060	8.6	NQ	NQ	NQ	NQ	0.990	0.200	NQ	NQ	NQ	NQ	NQ
Lower Currant Creek Below Diversions	Change	-83	nm	I	D	D	nm	nm	nm	I	1	nm	nm	1
	Value	957	9.0	NQ	NQ	NQ	NQ	0.130	0.070	NQ	NQ	NQ	NQ	NQ
Salt Creek	Change	nm	nm	nm	nm	nm	nm	nm	nm	D	D	nm	nm	D
	Value	5,470	8.5	6.7	70	70	NQ	0.210	0.210	NQ	NQ	NQ	NQ	NQ
West Creek	Change	+1,144	nm	I	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	11,544	9.5	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Upper Currant Creek	Change	nm	nm	nm	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	3,500	8.7	7.3	NQ	NQ	NQ	6.100	0.140	NQ	NQ	NQ	NQ	NQ
Mona Reservoir	Change	-110	nm	nm	nm	nm	nm	nm	nm	1	1	nm	nm	1
	Value	1,010	8.9	3.5	73	73	NQ	2.100	1.000	NQ	NQ	NQ	NQ	NQ

*For Strawberry Reservoir releases from above or below the thermocline. Changes in average temperature and phosphorus are based on comparison to historical temperatures, which include a mix of water from above and below the thermocline. Temperatures and phosphorus in the lower Spanish Fork River, Spring Creek, Beer Creek, Benjamin Slough, upper and lower Currant Creek, Salt Creek, West Creek, and Mona Reservoir are not dependent on Strawberry Reservoir releases.
Codes: nm = No measurable change; D = Unquantified decrease; I = Unquantified increase; NQ = Not quantified.

Table 3.3-8
Water Quality Resulting from the MCAP Alternative

Water quality changes in Mona Reservoir would result from changes in the quality of inflows from springs and upper Currant Creek and the direct delivery of water from the SFN System. The MCAP Alternative would reduce salinity in Mona Reservoir. This reduction occurs because the improvement in salinity resulting from the direct delivery of relatively low salinity water from the SFN System is greater than the degradation in salinity resulting from the increased salinity of inflows from springs and upper Currant Creek. Turbidity and total phosphorus concentrations could increase in Mona Reservoir because of the greater volume of water and turbulence in the reservoir, resulting in greater suspended solids. Effects on pH, BOD, nitrate, ammonia, and coliforms would not be measurable.

Water quality changes in lower Currant Creek would reflect both changes in the quality of inflow from Mona Reservoir and the changes in flow. The salinity in lower Currant Creek would decline, reflecting reduced salinity of waters derived from Mona Reservoir. The greater average and maximum flows in lower Currant Creek would increase its turbidity and total phosphorus concentrations. The greater flows could also result in an increase in the minimum dissolved oxygen because of improved aeration, a possible reduction in the peak temperature through the possible lowering of the average temperature in Mona Reservoir, and a possible elimination of relatively stagnant pools that would have warmer temperatures. The effects on pH, BOD, nitrate, ammonia, and coliforms would not be measurable.

3.3.6.5.2 Groundwater Quality. Groundwater quality impacts are considered under the two major categories of construction impacts and operation impacts.

3.3.6.5.2.1 Construction Impacts. Construction impacts on groundwater quality could be caused by accidental releases of fuels or other liquids. The potential for adverse impacts from spills would be minimized through spill containment and countermeasure requirements of the CUWCD's construction specifications.

3.3.6.5.2.2 Operation Impacts. In the southern Utah Valley portion of southern Utah County, the average groundwater salinity over the analysis period resulting from the MCAP Alternative (412 ppm of TDS) is almost the same as for baseline (413 ppm of TDS). The average salinity resulting from the MCAP Alternative is essentially the same as baseline because the additional salts brought in with the SFN System water are offset by dilution with the increased amount of groundwater being stored.

In the Goshen Valley portion of southern Utah Valley, changes in salinity would not be expected to be measurable because the magnitude of the increase in inflow to groundwater (1,300 acre-feet) would be small relative to the current inflow to groundwater (36,800 acre-feet). In addition, the quality of this recharge water would be similar to the existing quality (with the salinity of recharge water derived from lower Currant Creek being slightly reduced from the baseline salinity).

In the northern Juab Valley area of eastern Juab County, the MCAP Alternative would result in an increase of about 11 percent in the average groundwater salinity. The salinity increase would build up over the initial years of project operation and stabilize at an increase of about 14 percent (or 90 ppm) by the end of the period. The salinity increase would result primarily from the additional salt loading from leaching of salts from lands currently developed for agriculture but not irrigated.

The processes of irrigation and percolation of irrigation return flows would tend to increase dissolved oxygen and reduce BOD and could result in additional denitrification (conversion of nitrate to ammonium by oxidation), which reduces toxic forms of nitrogen. Temperatures would tend to equilibrate with the existing groundwater temperature.

3.3.6.5.3 Sedimentation. Estimates of the tons of sediment that would be transported as bed load and suspended sediment through each reach and the resulting concentrations of total suspended solids for the MCAP Alternative are presented in Table 3.3-10.

Table 3.3-10
Sediment Budget Resulting from the MCAP Alternative

Location		Sediment Transport (tons/year)	Total Suspended Solids (ppm)	Impacts
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change[a]	-6,500	-58	Decreased bank erosion; preservation of natural sediment accretions; bank stabilization; vegetation establishment.
	Value[b]	1,300	40	
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change[a]	+57,600	+186	Greatly increased sediment load; stream would widen significantly; banks would become less stable; channel bed would degrade in some locations; decreased sediment load after first years of operation.
	Value[b]	65,400	284	
Sixth Water Creek: Fifth Water Creek to Three Forks[c]	Change[a]	+57,600	+186	Reduced sediment loading and gradual stabilization as described for the previous reach.
	Value[b]	65,400	284	
Diamond Fork Creek: Three Forks to Red Hollow	Change[a]	+58,100	+125	Would become a reservoir and trap approximately 92 percent of incoming sediment.
	Value[b]	75,900	299	
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change[a]	-11,700	-70	Decreased bank erosion; releases from Monks Hollow Reservoir would not contain bedload, so stream channel geometry adjustment would not occur until about 2 miles downstream.
	Value[b]	14,800	147	

[a]Changes are based on the relative reduction from baseline conditions and are generally valid for either monthly or daily flows.
[b]Tons per year of sediment transportation based on the application of the prediction equation to monthly flows. This underestimates the sediment transported based on daily flows by about 10 to 15 percent.
[c]No analysis was conducted for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Tunnel to Fifth Water Creek.

3.3.6.5.4 Mitigation. No water quality mitigation would be required for the SFN System as a result of the MCAP Alternative. However, it is noted that the water quality mitigation commitment previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) remain in effect. Under these previous mitigation commitments, a water quality monitoring program of 5 to 10 years' duration will be performed in Diamond Fork Creek. If problems with temperatures or dissolved oxygen in Diamond Fork Creek occur, a multilevel outlet on Monks Hollow Dam, aerators or destratifiers on Strawberry or Monks Hollow Reservoirs, or warming ponds or aerators on Diamond Fork Creek below Monks Hollow Reservoir would be constructed, at project expense, as determined practical. Any power requirements would be small and would come from project power allocations.

3.3.6.5.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts would occur as a result of the MCAP Alternative at some locations with respect to TDS, phosphorus, and turbidity. Average and peak TDS concentrations would increase (but not significantly) in Sixth Water Creek above Sixth Water Tunnel, Diamond Fork Creek below Red Hollow, upper Spanish Fork River, West Creek, and upper Current Creek. Phosphorus concentrations would also increase at many locations and would increase significantly in Sixth Water Creek between Strawberry Tunnel and Fifth Water Creek when releases are made from below the thermocline. Significant increases in turbidity would occur in Sixth Water Creek from Sixth Water Tunnel to Three Forks,

Diamond Fork Creek from Three Forks to Red Hollow, the lower Spanish Fork River, lower Currant Creek (both above and below diversions), West Creek, upper Currant Creek, and Mona Reservoir.

3.3.6.6 MCAPW Alternative

Construction and sedimentation impacts of the MCAPW Alternative would be the same as those described previously for the MCAP Alternative. Water deliveries resulting from the MCAPW Alternative would be the same as those of the MCAP Alternative and would produce the same irrigation return flows, the same amount of water in Mona Reservoir, the same flows in Diamond Fork Creek below Monks Hollow Dam, and the same flows into Utah Lake. However, the flows in the upper Spanish Fork River between the confluence with Diamond Fork Creek and the Strawberry Diversion Dam would differ from the MCAP Alternative because of the conveyance of SVP and Bonneville Unit water in the Spanish Fork River rather than the Main Conveyance Aqueduct. Therefore, discussion in this section is limited to operation impacts on surface water quality in the upper Spanish Fork River. Impacts of the MCAPW Alternative are summarized in Section 3.3.6.11.

3.3.6.6.1 Surface Water Quality. Changes in water quality in the upper Spanish Fork River would be the same as those discussed for the MCAP Alternative, except for salinity, phosphorus, temperature, and turbidity. The MCAPW Alternative would result in an average salinity of 278 ppm (a reduction from baseline of 23 ppm) and a maximum salinity of 425 ppm (a reduction from baseline of 64 ppm). The greater average and peak flows would result in increases in turbidity (with a baseline average of 249 NTUs and a baseline peak of 2,047 NTUs). Phosphorus concentrations would remain in exceedence of standards and would average 0.052 ppm if all releases were from above the thermocline at Strawberry Reservoir and 0.184 ppm if all releases were from below the thermocline. Peak phosphorus concentrations could reach 0.361 ppm, which, although reduced from baseline, remains in exceedence of standards. The average temperature would be 57°F when releases are made from above the thermocline (the same as baseline) and 49°F when releases are made from below the thermocline (a reduction of 8°F from baseline). The maximum temperature would be 69°F when releases are made from above the thermocline (a reduction of 6°F from baseline) and 52°F when releases are made from below the thermocline (a reduction of 23°F from baseline).

3.3.6.6.2 Mitigation. No water quality mitigation would be required under the MCAPW Alternative. However, it is noted that the water quality mitigation commitments previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) remain in effect, as discussed in Section 3.3.6.5.4.

3.3.6.6.3 Unavoidable Adverse Impacts. The unavoidable adverse impacts would the same as those discussed for the MCAP Alternative, except that there would be an unavoidable significant adverse impact on turbidity in the upper Spanish Fork River.

3.3.6.7 MCATC Alternative

Water deliveries under the MCATC Alternative would be the same as those of the MCAP Alternative, result in the same irrigation return flows, convey the same quantities of water in Diamond Fork Creek and the Spanish Fork River, and store the same amount of water in Mona Reservoir. Therefore, the impacts of the MCATC Alternative would be identical to those previously discussed for the MCAP Alternative. Significant impacts of the MCATC Alternative on water quality are summarized in Section 3.3.6.11.

3.3.6.8 MCAT Alternative

Construction and sedimentation impacts of the MCAT Alternative would be the same as those described previously for the MCAP Alternative. Water deliveries resulting from the MCAT Alternative would be the same as those

of the MCAP Alternative, result in the same irrigation return flows, and store the same amount of water in Mona Reservoir. However, it differs from the MCAP Alternative in that SWUA water would be conveyed in the upper Spanish Fork River to the Strawberry Diversion Dam, rather than within the Main Conveyance Aqueduct. Therefore, discussion in this section is limited to operation impacts on surface water quality in the upper Spanish Fork River. Significant impacts of the MCAT Alternative are summarized in Section 3.3.6.11.

3.3.6.8.1 Surface Water Quality. Changes in water quality in the upper Spanish Fork River would be the same as those discussed for the MCAP Alternative, except for salinity, phosphorus, temperature, and turbidity. Under the MCAT Alternative, water from Strawberry Reservoir would constitute a greater proportion of the flow in the upper Spanish Fork River, which would result in an average salinity of 273 ppm (a reduction from baseline of 28 ppm) and a maximum salinity of 425 ppm (a reduction from baseline of 64 ppm). The greater average and peak flows would result in increases in turbidity (with a baseline average of 249 NTUs and a baseline peak of 2,047 NTUs). Phosphorus concentrations would remain in exceedence of standards, averaging 0.109 ppm (a reduction from baseline of 0.054 ppm) when releases were from above the thermocline at Strawberry Reservoir and 0.197 ppm (an increase of 0.034 ppm over baseline) if all releases were from below the thermocline. Peak phosphorus would be reduced, but not enough to mitigate the baseline peak of 0.718 ppm. The average temperature would be 58°F when releases are made from above the thermocline (an increase of 1°F from baseline) and 49°F when releases are made from below the thermocline (a reduction of 8°F from baseline). The maximum temperature would be 69°F when releases are made from above the thermocline (a reduction of 6°F from baseline) and 52°F when releases are made from below the thermocline (a reduction of 23°F from baseline).

3.3.6.8.2 Mitigation. No water quality mitigation would be required under the MCAT Alternative. However, it is noted that the water quality mitigation commitments previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) remain in effect, as discussed previously in Section 3.3.6.5.4.

3.3.6.8.3 Unavoidable Adverse Impacts. The unavoidable adverse impacts would be the same as those discussed for the MCAP Alternative, except that there would also be an unavoidable significant adverse impact on turbidity in the upper Spanish Fork River.

3.3.6.9 No Action Alternative

The No Action Alternative would result in changes to groundwater and surface water quality. These changes would be limited to southern Utah Valley, as the No Action Alternative would result in no deliveries to eastern Juab County or the Goshen Valley area of southern Utah County. No improvements in conveyance or on-farm efficiencies are projected to occur in association with the No Action Alternative. Significant impacts of the No Action Alternative are summarized in Section 3.3.6.11.

3.3.6.9.1 Surface Water Quality. Water quality conditions resulting from the No Action Alternative and the changes in water quality relative to the baseline are shown in Table 3.3-11. Because there are no impacts in eastern Juab County or the Goshen Valley area of southern Utah County, surface water features in these areas are not included in the discussion.

The No Action Alternative would result in slightly higher annual average TDS in all reaches shown in Table 3.3-11 except the upper Spanish Fork River. Increases in salinity in Spring Creek, Beer Creek, and Benjamin Slough would be due to groundwater seepage. On the average, salinity would increase in the Diamond Fork drainage because some or a larger proportion of the low salinity water from Strawberry Reservoir would be carried in the Diamond Fork System conveyance facilities. Because a larger share of Spanish Fork River water would have its source above the confluence of the Diamond Fork River, operation of the Diamond Fork

Table 3.3-11
Water Quality Resulting from the No Action Alternative

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Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Average Water Quality														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+55	nm	nm	-8	-16	nm	nm	nm	-0.041	+0.105	nm	nm	D
	Value	238	8.1	7.3	51	43	3.2	0.376	0.069	0.007	0.153	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	+37	nm	nm	-10	-18	nm	nm	nm	-0.044	+0.108	nm	nm	I
	Value	233	8.1	NQ	49	41	2.4	0.377	0.088	0.004	0.156	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	+18	nm	nm	-9	-17	nm	nm	nm	-0.077	+0.071	nm	nm	I
	Value	240	8.2	9.4	49	41	1.2	0.099	0.038	0.020	0.168	NQ	NQ	NQ
Diamond Fork Creek: Three Forks to Red Hollow	Change	+32	nm	nm	-6	-14	nm	nm	nm	-0.079	+0.060	nm	nm	D
	Value	245	8.1	7.0	51	43	1.6	0.510	0.025	0.024	0.163	NQ	NQ	NQ
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change	+28	nm	nm	-6	-13	nm	nm	nm	-0.079	+0.060	nm	nm	I
	Value	241	8.1	7.0	51	44	1.6	0.510	0.025	0.024	0.163	NQ	NQ	NQ
Upper Spanish Fork River	Change	-16	nm	nm	-5	-11	nm	nm	nm	-0.085	+0.025	nm	nm	I
	Value	285	8.2	8.0	52	46	3.0	0.589	0.020	0.078	0.188	NQ	NQ	NQ
Lower Spanish Fork River	Change	D	nm	nm	D	D	nm	nm	nm	I	I	nm	nm	I
	Value	NQ	8.1	8.5	NQ	NQ	NQ	0.220	0.120	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	+11	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	539	8.2	9.2	48	48	NQ	1.000	0.050	0.161	0.161	NQ	NQ	37
Beer Creek	Change	+16	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	811	7.9	8.1	54	54	NQ	1.000	0.280	0.340	0.340	NQ	NQ	26
Benjamin Slough	Change	+20	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,018	8.4	12.9	57	57	3.0	1.500	0.120	0.120	0.120	6,207	242	29

Table 3.3-11
Water Quality Resulting from the No Action Alternative

Table 3.3-11
Water Quality Resulting from the No Action Alternative

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Affected Water Feature		Key Water Quality Parameters												
		TDS (ppm)	pH	Dissolved Oxygen (ppm)	Temperature* (°F)		BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus* (ppm)		Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTUs)
					Above	Below				Above	Below			
Maximum* Levels														
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change	+21	nm	I	0	-20	nm	nm	nm	-0.044	+0.076	nm	nm	D
	Value	295	8.6	NQ	67	47	3.2	0.770	0.400	0.037	0.157	NQ	NQ	NQ
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change	0	nm	I	-2	-22	nm	nm	nm	-0.283	-0.143	nm	nm	I
	Value	294	8.5	NQ	65	45	2.4	0.510	0.680	0.017	0.157	NQ	NQ	NQ
Sixth Water Creek: Fifth Water Creek to Three Forks	Change	-135	nm	nm	-4	-25	nm	nm	nm	-0.479	-0.381	nm	nm	I
	Value	297	8.6	8.8	66	45	1.3	2.200	0.690	0.091	0.189	NQ	NQ	NQ
Diamond Fork Creek:[f] Three Forks to Red Hollow	Change	-85	nm	I	-1	-21	nm	nm	nm	-0.517	-0.409	nm	nm	D
	Value	298	8.6	NQ	69	49	2.0	2.100	0.310	0.092	0.200	NQ	NQ	NQ
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change	-85	nm	I	-1	-21	nm	nm	nm	-0.517	-0.390	nm	nm	I
	Value	298	8.6	NQ	69	49	2.0	2.100	0.310	0.092	0.219	NQ	NQ	NQ
Upper Spanish Fork River	Change	-138	nm	I	-6	-22	nm	nm	nm	-0.436	-0.376	nm	nm	I
	Value	351	8.5	NQ	69	53	4.5	2.500	0.050	0.282	0.342	NQ	NQ	NQ
Lower Spanish Fork River	Change	nm	nm	nm	nm	nm	nm	nm	nm	I	I	nm	nm	I
	Value	1,260	9.0	0.3	84	84	NQ	0.800	1.000	NQ	NQ	NQ	NQ	NQ
Spring Creek	Change	+22	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,138	8.6	4.7	77	77	NQ	6.100	0.510	1.612	1.612	NQ	NQ	310
Beer Creek	Change	+31	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,591	8.6	1.9	82	82	NQ	1.900	0.920	0.740	0.740	NQ	NQ	70
Benjamin Slough	Change	+32	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
	Value	1,646	8.5	8.8	75	75	NQ	1.700	0.320	0.270	0.270	NQ	NQ	32

*For Strawberry Reservoir releases from above or below the thermocline. Change in average temperature and phosphorus are based on comparison to historical temperatures, which include a mix of water from above and below the thermocline. Temperatures and phosphorus in the lower Spanish Fork River, Spring Creek, Beer Creek, Benjamin Slough, upper and lower Currant Creek, Salt Creek, West Creek, and Mona Reservoir are not dependent on Strawberry Reservoir releases.
Codes: nm = No measurable change; D = Unquantified decrease; I = Unquantified increase; NQ = Not quantified.

Table 3.3-11
Water Quality Resulting from the No Action Alternative

drainage would have less impact here. Peak salinity would, on the other hand, generally decrease. Because of the warm saline springs on Fifth Water Creek, Cottonwood Creek, and upper Diamond Fork Creek, winter flows historically often have had the highest salinity. Under the No Action Alternative, minimum streamflows, although small, would bring enough low salinity water down the drainage to dilute some of the natural high salinity winter flows. The magnitude of most changes in salinity would be small and not significant.

Diversions to the Diamond Fork Pipeline would reduce from baseline the average and maximum flow from Red Hollow to the confluence with the upper Spanish Fork River. These reduced flows would result in less erosion and lower suspended solids concentrations and a corresponding reduction in average and peak turbidity. The increased average and peak flows in Sixth Water Creek from Sixth Water Tunnel to Three Forks, Diamond Fork Creek above Red Hollow, and the upper and lower Spanish Fork River would result in increased average and peak turbidity. The increased minimum flows would produce increased aeration, which would result in increased dissolved oxygen levels.

The impact of the No Action Alternative on phosphorus concentrations from Sixth Water Creek to the upper Spanish Fork River would depend on whether releases were made from above or below the thermocline. Average and peak phosphorus concentrations would be reduced when releases were made from below the thermocline. Average concentrations would generally increase if releases were made from above the thermocline. However, peak concentrations would be reduced when releases were made from above the thermocline, because the minimum flows would tend to dilute high phosphorus levels in the natural flows during low flow periods.

Temperatures would vary, depending on whether releases from Strawberry Reservoir were made from the relatively warm water above the thermocline or the relatively cool water below the thermocline. Because the outlet from Strawberry Reservoir releases water from a single elevation, water cannot be selectively released from above or below the thermocline. In addition to the flow-weighted average temperatures shown in Table 3.3-11, estimated temperatures for the releases made from above and below the thermocline as a result of the Proposed Action are presented in Table 3.3-12. As estimated previously in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990), releases would be made entirely from above the thermocline in 15 to 35 percent of the years, entirely from below the thermocline in 35 to 55 percent of the years, and from both above and below the thermocline (during different parts of the year) in 20 to 40 percent of the years. Both average and peak temperatures would be reduced as a result of the No Action Alternative.

Table 3.3-12
Monthly Average Temperatures in Sixth Water Creek, Diamond Fork Creek, and the Upper Spanish Fork River Resulting from the No Action Alternative

Month	Strawberry Reservoir Releases Made from Above the Thermocline			Strawberry Reservoir Releases Made from Below the Thermocline		
	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River (°F)	Sixth Water Creek (°F)	Diamond Fork Creek (°F)	Upper Spanish Fork River (°F)
May	49 to 50	50	55	42 to 43	46	53
June	61	63	62	43 to 46	47	51
July	65 to 67	69	69	44 to 47	48	52
August	65 to 66	68	68	45 to 47	49	53
September	62 to 63	65	64	45 to 46	48	51

*Based on results presented in the *Hydrology and Water Resources Technical Report* (CUWCD 1998b).

Impacts to ammonia, pH, BOD, nitrates, and coliforms would be similar to those of the Proposed Action in that no measurable changes would occur.

Changes in the groundwater salt balance (discussed more fully in Section 3.3.6.9.2) or in the quantity of springflows could result in changes in the salinity of surface water features fed by springs. These changes in the quality and amount of springflows would result in an increase of about 2 percent in the salinity of the spring-fed features (specifically, Spring Creek, Beer Creek, and Benjamin Slough). Since the average flow in the spring-fed features would be the same as the average baseline flow, the measurable changes in turbidity, total phosphorus, minimum dissolved oxygen levels, or temperatures would not be expected.

The No Action Alternative would result in a slight improvement in the concentrations of trace elements in the Benjamin Slough area (i.e., their concentrations would decrease slightly from baseline conditions). Therefore, no adverse impacts related to trace elements would be expected.

3.3.6.9.2 Groundwater Quality. In the southern Utah Valley portion of southern Utah County, the average groundwater salinity over the analysis period resulting from the No Action Alternative is about 2 percent higher than the baseline salinity. There are slight variations in salinity in individual years. The additional salts brought in with the additional water delivered for M&I and irrigation use would be contained in essentially the same volume of groundwater in storage, resulting in a slight increase in the average groundwater salinity.

3.3.6.9.3 Sedimentation. Estimates of the tons of sediment that would be transported through each reach as bed load and suspended sediment and the resulting concentration of total suspended solids for the No Action Alternative are presented in Table 3.3-13.

Table 3.3-13
Sediment Budget Resulting from the No Action Alternative

Location		Sediment Transport (tons/year)	Total Suspended Solids (ppm)	Impacts
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel	Change[a]	-6,500	-58	Decreased bank erosion; preservation of natural sediment accretions; bank stabilization; vegetation establishment.
	Value[b]	1,300	40	
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek	Change[a]	+17,100	+13	Greatly increased sediment load; stream will widen significantly; banks will become less stable; channel bed would degrade in some locations; decreased sediment load after first years of operation.
	Value[b]	24,900	111	
Sixth Water Creek: Fifth Water Creek to Three Forks[c]	Change[a]	+17,100	+13	Increased sediment; intermittent deposition of coarse sediment depending on sediment management operations at the Diamond Fork Pipeline diversion structure.
	Value[b]	24,900	111	
Diamond Fork Creek: Three Forks to Red Hollow	Change[a]	+18,100	-30	Decreased bank erosion; gradual narrowing of channel; braided sections would become more stable and develop a single, dominant channel.
	Value[b]	35,900	144	
Diamond Fork Creek: Red Hollow to Spanish Fork River	Change[a]	-4,500	+11	Decreased bank erosion; releases from Monks Hollow Reservoir would not contain bedload, so stream channel geometry adjustment would not occur until about 2 miles downstream.
	Value[b]	22,000	228	

[a]Changes are based on the relative reduction from baseline conditions and are generally valid for either monthly or daily flows.
[b]Tons per year of sediment transportation based on the application of the prediction equation to monthly flows. This underestimates the sediment transported based on daily flows by about 10 to 15 percent.
[c]No analysis was conducted for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Tunnel to Fifth Water Creek.

3.3.6.9.4 Mitigation. No water quality mitigation would be required under the No Action Alternative. However, it is noted that the water quality mitigation commitments previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) remain in effect, as discussed previously in Section 3.3.6.5.4.

3.3.6.9.5 Unavoidable Adverse Impacts. As a result of the No Action Alternative, unavoidable adverse impacts would occur at some locations with respect to TDS, phosphorus, and turbidity. Average and peak TDS concentrations would increase (but not significantly) in Sixth Water Creek, Diamond Fork Creek, Spring Creek, Beer Creek, and Benjamin Slough. Phosphorus concentrations would also increase at many locations, and the average phosphorus concentration would increase significantly in Sixth Water Creek between Strawberry Tunnel and Fifth Water Creek when releases are made from below the thermocline. Significant increases in turbidity would occur in Sixth Water Creek from Sixth Water Tunnel to Three Forks, Diamond Fork Creek from Three Forks to Red Hollow, and the upper and lower Spanish Fork River.

3.3.6.10 Impacts of Project Alternatives on Contaminants

Technical data that could be used with other information to define baseline conditions for trace metals and estimate project impacts is discussed in the *Environmental Contaminants Technical Report* (CUWCD 1997a) and is summarized in this section. Selected testing was conducted in 1993 and 1994 on the surface water, sediments, fish tissues, bird eggs, aquatic invertebrates, and plants. Continued testing is being conducted to refine the contaminant study. Because concentrations in the surface waters were at such low levels, tissue and sediment samples are discussed below only as an indicators of water quality.

3.3.6.10.1 Significance Criteria. Impacts are defined as changes resulting from the project alternatives that could mobilize or redistribute contaminants in such a manner as to exceed State water quality standards (Utah Department of Environmental Quality 1994) or to create toxic conditions for wildlife. Utah's standards for 4-day exposure were used as the criteria for mean water quality; State standards for 1-hour exposure were used as the criteria for maximum levels of contaminants allowed in water. Permissible exposure limits (the concentration above which adverse biologic effects are likely to occur) were used as a guideline only to discuss levels of contaminants in sediments. The National Freshwater Fish Contaminant Biomonitoring Program 85th percentile elevated level was used as a guideline only to discuss levels of contaminants in fish tissue. The "high" levels of contaminants defined by Puls (CUWCD 1997a) were used as a guideline only to discuss levels of contaminants in bird diets (invertebrates, fish, and aquatic plants).

3.3.6.10.2 Affected Environment. The following text focuses on key contaminants (those for which initial tissue sampling showed detectable levels; specifically, arsenic, boron, chromium, copper, mercury, lead, selenium and zinc). A full suite of analyses was run on surface water samples; results showed that only arsenic, boron, selenium, and zinc were above detection levels. Baseline levels of contaminants in sediments were very low and sediment results were eliminated from the impact analysis. Selenium is the contaminant of most widespread concern with elevated levels in fish, invertebrate, and bird egg tissues. Zinc, copper, and arsenic are of lesser concern and elevated levels appear to be limited to fish tissue.

The different levels of contaminants in the surface waters reflect source area geology, agricultural runoff, and the level of dilution and transport offered by flow volume. In the summer, concentrations of contaminants may be higher because of evaporation from bodies of standing water and the introduction of seasonal agricultural drainage. Although trends in contaminants generally follow the trends of TDS, if there is no source of a particular contaminant, this generalization will not hold true.

In general, the contaminant study showed that Diamond Fork and Summit Creeks have low TDS and contaminant concentrations compared to the other locations. West Creek has high TDS, but no corresponding high values for selenium or other contaminants. Arsenic, boron, selenium, and zinc are the primary contaminants in the surface

waters above detection levels. The concentration of selenium in the waters of upper Currant Creek is the only contaminant that is near the significance criteria. Although boron is moderately high, there are no impact guidelines for wildlife.

Additional data were collected in the upper Currant Creek drainage in 1997 as discussed in the report *Draft Spanish Fork Canyon/Nephi Irrigation System Plan for Prevention of Harmful Contamination* (CUWCD 1997d). These data indicated that the likely source within Juab Valley is upper West Creek.

Elevated mean levels of contaminants in tissues are of concern. Occasional anomalous high concentrations of contaminants in tissues are thought to be outliers or attributed to outside-area food sources of migratory birds. All samples showed virtually undetectable levels of cadmium, lead, and mercury. Detectable levels of most trace elements were within normal concentration ranges, selenium being the contaminant of most concern. In general, concentrations of most trace elements were higher in the summer than in the fall and slightly higher in the lower elevation locations.

Although State water quality standards (Utah Department of Environmental Quality 1994) are not exceeded, tissue samples showed elevated levels indicative of bioaccumulations of arsenic, copper, selenium, and zinc at Benjamin Slough and copper, selenium, and zinc in eastern Juab County. Contaminants are virtually undetectable in Diamond Fork Creek, the Spanish Fork River, and Salt Creek.

Baseline conditions and estimates of conditions under the project alternatives are presented in table format in Appendix D, *Contaminant Report Summary Tables*. Detailed discussion is presented in the *Environmental Contaminants Technical Report* (CUWCD 1997a). Results are based on the mean and maximum concentrations that occur in the surface waters at Diamond Fork Creek below Red Hollow, Spanish Fork River at Castilla, Summit Creek above Santaquin, Salt Creek above Nephi, Benjamin Slough at Utah Lake, West Creek west of Nephi, Currant Creek above Mona Reservoir, and Currant Creek near Elberta.

3.3.6.10.3 Proposed Action. The predictions of contaminant concentrations are based on the general trend that contaminants are mobilized during higher flows. It should be noted that until more data are gathered, these changes may contain a high degree of uncertainty.

Levels of contaminants in the surface waters of Diamond Fork Creek and the Spanish Fork River may decrease, although the reductions would probably be small. The Proposed Action would have no impact on Salt Creek. As a result of low baseline levels and no anticipated increases in the contaminants in the water, these locations were not tested for bioaccumulation.

Levels of contaminants in tissues of organisms and in surface waters in lower Currant Creek may decrease, although negligibly. The levels of contaminants in West Creek, upper Currant Creek, and Benjamin Slough may show small increases. The changes may be from 0.5 to 1.0 micrograms per gram dry weight, which are not enough to either mitigate a baseline elevated level or cause a currently acceptable level to become elevated. Given there is no agreement on threshold levels of contaminants, particularly selenium, the exact impacts of increases over already elevated levels are difficult to assess.

3.3.6.10.4 MCAPW-DFT Alternative. The MCAPW-DFT Alternative would have the same impact as the Proposed Action, except that the probable reduction in contaminant levels in the Spanish Fork River would be slightly less than those that would result from the Proposed Action.

3.3.6.10.5 MCAP Alternative. The MCAP Alternative would have the same impacts as the Proposed Action.

3.3.6.10.6 MCAPW Alternative. The MCAPW Alternative would have the same impact as the Proposed Action, except that the probable reduction in contaminant levels in the Spanish Fork River would be slightly less than those that would result from the Proposed Action.

3.3.6.10.7 MCATC Alternative. The MCATC Alternative would have the same impacts as the Proposed Action.

3.3.6.10.8 MCAT Alternative. The MCAT Alternative is essentially the same as the Proposed Action, except that the probable reductions in contaminant levels in the Spanish Fork River would be slightly less than those that would occur under the Proposed Action.

3.3.6.10.9 No Action Alternative. The No Action Alternative would not deliver water to eastern Juab County; therefore, there would be no changes from baseline in Salt Creek, West Creek, or upper and lower Currant Creek. The decrease in levels of contaminants in Diamond Fork Creek and the Spanish Fork River would be slightly less than those that would occur under the Proposed Action. The No Action Alternative could result in slightly lower levels of contaminants carried through Benjamin Slough, which may result in slightly lower bioaccumulations.

3.3.6.10.10 Summary of Impacts of Project Alternatives. The Proposed Action and all alternatives do not exhibit significantly different impacts with respect to contaminants. These differences likely fall within the uncertainty of the prediction equation that was used to estimate impacts. Additionally, State water quality standards (Utah Department of Environmental Quality 1994) and guidelines from other regulatory sources do not agree on toxicity levels. Ongoing sampling and analyses are being conducted in cooperation with the FWS to resolve these issues.

3.3.6.11 Summary of Impacts

Significant impacts to the key water quality parameters are shown in Table 3.3-14 and include both of the following:

- Changes that are significant (causing exceedence in a baseline value that is within the standards or mitigation of a baseline value that exceeds the standard)
- Changes where baseline is already in exceedence of standards

Numerous small changes in TDS, pH, BOD, nitrate, and coliforms that are not measurable and small changes where baseline values are well below the standards were excluded from Table 3.3-14.

Where applicable, each surface water feature is further subdivided into impacts when releases from Strawberry Reservoir are made from above the thermocline, impacts when releases are made from below the thermocline, and impacts that are independent of the thermocline in Strawberry Reservoir. Releases from above and below the thermocline only occur from June through September.

If the change is significant relative to the criteria established in Section 3.3.6.1, the significance is denoted as "YES." For those impacts where multiple processes contribute to change, impacts are unquantified or approximate, or baseline data are lacking, the significance is denoted as "Possible." If the impact does not cause a change relative to the standard, the significance is denoted as "NO."

While no mitigation is proposed for the SFN System, it is noted that the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) included water quality monitoring and mitigation commitments for temperature and dissolved oxygen. Also, an existing phosphorus reduction program at Strawberry Reservoir is in progress and is projected to reduce the phosphorus by 50 percent in 20 years.

Table 3.3-14
Summary of Impacts for Water Quality
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Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action			
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel			
Releases from below the thermocline[a]			
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Increased average annual phosphorus	Yes (adverse)	None proposed	Yes
Increase maximum phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[b]			
Decrease maximum phosphorus	Yes (beneficial)	NA	Yes
All Releases			
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek			
Releases from below the thermocline[a]			
Increase average annual phosphorus	Yes (adverse)	None proposed	Yes
Decrease maximum phosphorus	No (beneficial)	None proposed	No
Releases from above the thermocline[b]			
Decrease maximum phosphorus	Yes (beneficial)	NA	Yes
All Releases			
Increase dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease maximum and average annual turbidity	Yes (beneficial)	NA	Yes
Sixth Water Creek: Fifth Water Creek to Three Forks			
All Releases			
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Decrease in maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average annual turbidity	Yes (beneficial)	NA	Yes
Diamond Fork Creek: Three Forks to Red Hollow			
Releases from below the thermocline[a]			
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Releases from above the thermocline[b]			
Decrease maximum temperature	No (beneficial)	NA	No
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
All Releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average annual turbidity	Yes (beneficial)	NA	Yes

Table 3.3-14
Summary of Impacts for Water Quality

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Impact	Significance	Mitigation	Significance After Mitigation
Diamond Fork Creek Below Red Hollow			
Releases from below the thermocline[a]			
Increase average annual phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[b]			
Decrease average annual phosphorus	No (beneficial)	NA	No
All Releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average annual turbidity	Yes (beneficial)	NA	Yes
Upper Spanish Fork River			
All Releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average annual turbidity	Yes (beneficial)	NA	Yes
Lower Spanish Fork River			
Increase average and maximum phosphorus	No (adverse)	None proposed	No
Increase maximum and average annual turbidity	Yes (adverse)	None proposed	Yes
Salt Creek			
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease average and peak turbidity	Yes (beneficial)	NA	Yes
West Creek			
Increase in maximum and average annual turbidity	No (adverse)	None proposed	No
Increase in maximum and average annual phosphorus	No (adverse)	None proposed	No
Increase in maximum and average annual TDS	No (adverse)	None proposed	No
Upper Currant Creek			
Decrease in maximum temperature	No (beneficial)	NA	No
Increase in maximum and average annual turbidity	Yes (adverse)	None proposed	Yes
Increase in maximum and average annual phosphorus	No (adverse)	None proposed	No
Lower Currant Creek Above Diversions			
Increase in maximum and average annual turbidity	Yes (adverse)	None proposed	Yes
Increase in maximum and average annual phosphorus	No (adverse)	None proposed	No
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease in maximum temperature	No (beneficial)	NA	No

Table 3.3-14
Summary of Impacts for Water Quality

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Impact	Significance	Mitigation	Significance After Mitigation
Lower Currant Creek Below Diversions			
Decrease maximum temperature	No (beneficial)	NA	No
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Increase in maximum and average annual turbidity	Yes (adverse)	None proposed	Yes
Increase in maximum phosphorus	No (adverse)	None proposed	No
Increase in average phosphorus	Yes (adverse)	None proposed	Yes
MCAPW-DFT Alternative			
Upper Spanish Fork River			
Releases from below the thermocline[a]			
Increase average annual phosphorus	No[c] (adverse)	None proposed	No
Releases from above the thermocline[b]			
Decrease of average annual phosphorus	No (beneficial)	NA	No
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
All other locations			
Same as Proposed Action			
MCAP Alternative			
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel			
Releases from below the thermocline[a]			
Increased average annual phosphorus	Yes (adverse)	None proposed	Yes
All releases			
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Increase maximum phosphorus	No (adverse)	None proposed	No
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek			
Releases from below the thermocline[a]			
Increased average annual phosphorus	Yes (adverse)	None proposed	Yes
Decrease maximum phosphorus	No (beneficial)	NA	No
Releases from above the thermocline[b]			
Decrease maximum phosphorus	Yes (beneficial)	NA	Yes
All releases			
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes

Table 3.3-14
Summary of Impacts for Water Quality

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Impact	Significance	Mitigation	Significance After Mitigation
Sixth Water Creek: Fifth Water Creek to Three Forks			
Releases from below the thermocline[a]			
Increase average phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[b]			
Decrease average phosphorus	Yes (beneficial)	NA	Yes
All releases			
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Decrease in maximum phosphorus	No (beneficial)	NA	No
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Diamond Fork Creek: Three Forks to Red Hollow			
Releases from below the thermocline[a]			
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Increase average phosphorus	No (adverse)	None proposed	No
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Releases from above the thermocline[b]			
Decrease maximum temperature	No (beneficial)	NA	No
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease average phosphorus	Yes (beneficial)	NA	Yes
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Diamond Fork Creek Below Red Hollow			
Releases from below the thermocline[a]			
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Releases from above the thermocline[b]			
Decrease average phosphorus	Yes (beneficial)	NA	Yes
Decrease maximum temperature	No (beneficial)	NA	No
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Upper Spanish Fork River			
Releases from below the thermocline[a]			
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Releases from above the thermocline[b]			
Decrease average annual phosphorus	No (beneficial)	NA	No
Decrease maximum temperature	No (beneficial)	NA	No

Table 3.3-14
Summary of Impacts for Water Quality

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Impact	Significance	Mitigation	Significance After Mitigation
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Lower Spanish Fork River			
Increase in maximum and average phosphorus	No (adverse)	None proposed	No
Increase in maximum and average annual turbidity	Yes (adverse)	None proposed	Yes
All other features			
Same as Proposed Action			
MCAPW Alternative			
Upper Spanish Fork River			
Releases from below the thermocline[a]			
Increase average annual phosphorus	Yes (adverse)	None proposed	Yes
Decrease maximum temperature	No (beneficial)	NA	No
Releases from above the thermocline[b]			
Decrease of average annual phosphorus	No (beneficial)	NA	No
Decrease maximum temperature	No (beneficial)	NA	No
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
All other locations			
Same as MCAP Alternative			
MCATC Alternative			
All Locations			
Same as MCAP Alternative			
MCAT Alternative			
Upper Spanish Fork River			
Releases from below the thermocline[a]			
Increase average annual phosphorus	No (adverse)	None proposed	No
Decrease maximum temperature	Yes (beneficial)	NA	Yes
Releases from above the thermocline[b]			
Decrease of average annual phosphorus	No (beneficial)	NA	No
Decrease maximum temperature	No (beneficial)	NA	No
All releases			
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes

Table 3.3-14
Summary of Impacts for Water Quality
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Impact	Significance	Mitigation	Significance After Mitigation
All other locations			
Same as MCAP Alternative			
No Action Alternative			
Sixth Water Creek: Strawberry Tunnel to Sixth Water Tunnel			
Releases from below the thermocline[c]			
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Increased average annual phosphorus	Yes (adverse)	None proposed	Yes
Increase maximum phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[d]			
Decrease maximum phosphorus	Yes (beneficial)	NA	Yes
Decrease maximum temperature raises allowable ammonia	Possibly (beneficial)	NA	Possibly
All releases			
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Sixth Water Creek: Sixth Water Tunnel to Fifth Water Creek			
Releases from below the thermocline[c]			
Increased average annual phosphorus	Yes (adverse)	None proposed	Yes
Decrease maximum phosphorus	No (beneficial)	NA	No
Releases from above the thermocline[d]			
Decrease maximum phosphorus	Yes (beneficial)	NA	Yes
All releases			
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Sixth Water Creek: Fifth Water Creek to Three Forks			
Releases from below the thermocline[c]			
Increase in average annual phosphorus	No (adverse)	None proposed	No
Decrease maximum phosphorus	No (beneficial)	NA	No
Releases from above the thermocline[d]			
Decrease average annual phosphorus	Yes (beneficial)	NA	Yes
Decrease maximum phosphorus	No (beneficial)	NA	No
All releases			
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Diamond Fork Creek: Three Forks to Red Hollow			
Releases from below the thermocline[c]			
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Increase average annual phosphorus	No[c] (adverse)	None proposed	No

Table 3.3-14
Summary of Impacts for Water Quality

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Impact	Significance	Mitigation	Significance After Mitigation
Releases from above the thermocline[d]			
Decrease maximum temperature	No (beneficial)	NA	No
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease average annual phosphorus	Yes (beneficial)	NA	Yes
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Decrease maximum and average turbidity	Yes (beneficial)	NA	Yes
Diamond Fork Creek Below Red Hollow			
Releases from below the thermocline[c]			
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Decrease maximum temperature raises allowable ammonia	Yes (beneficial)	NA	Yes
Increase average annual phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[d]			
Decrease maximum temperature	No (beneficial)	NA	No
Decrease maximum temperature raises allowable ammonia	No (beneficial)	NA	No
Decrease average annual phosphorus	Yes (beneficial)	NA	Yes
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Upper Spanish Fork River			
Releases from below the thermocline[c]			
Decrease in maximum temperature	Yes (beneficial)	NA	Yes
Increase average annual phosphorus	No (adverse)	None proposed	No
Releases from above the thermocline[d]			
Decrease maximum temperature	No (beneficial)	NA	No
Decrease average annual phosphorus	No (beneficial)	NA	No
All releases			
Increase minimum dissolved oxygen	Possibly (beneficial)	NA	Possibly
Decrease maximum phosphorus	No (beneficial)	NA	No
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Lower Spanish Fork River			
Increase maximum and average turbidity	Yes (adverse)	None proposed	Yes
Increase maximum and average annual phosphorus	No[c] (adverse)	None proposed	No
Beer Creek and Benjamin Slough			
Increase maximum TDS	No (adverse)	None proposed	No

[a]Releases from below the thermocline occur in 25 to 40 percent of the years.
[b]Releases from above the thermocline occur in 35 to 55 percent of the years.
[c]Releases from below the thermocline occur in 35 to 55 percent of the years.
[d]Releases from above the thermocline occur in 15 to 35 percent of the years.

3.3.7 Cumulative Impacts

The projects considered for cumulative impacts, identified in Section 1.8, would not be expected to impact surface water or groundwater quality. Therefore, the cumulative impacts would be the same as the SFN System impacts summarized in Section 3.3.6.11. The one exception is Utah Lake, which is discussed in Chapter 2.

3.4 Wetland Resources

3.4.1 Introduction

The information and analysis provided in this section was summarized from the *Wetland Resources Technical Report* (CUWCD 1998d). This section addresses potential impacts on wetland resources resulting from construction, operation, and maintenance of the SFN System.

For wetland resources, baseline conditions are the conditions that existed at the time the field studies were performed (1994-1995). Baseline conditions were determined through a combination of direct field observations, recently published literature on resources in the area, information presented in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990), and discussions with agency personnel with knowledge of the wetland resources present.

3.4.2 Issues Eliminated from Further Analysis

CUP water is not authorized and will not be allocated for irrigation use in any wetland habitats; therefore, conversion as a result of supplying water would not occur. Lands currently designated as ineligible to receive project water (6W land and sub-irrigated pasture) encompass the majority of the identified wetlands in the SFN System wetland impact area of influence (see Section 3.4.4). Potential conversion of wetlands to croplands or the supplemental irrigation of wetlands are not addressed in this DEIS since SFN System water contracts would only allow supplemental and full-service irrigation water to be used on lands currently in agricultural production.

3.4.3 Issues Addressed in the Impact Analysis

The following issues and concerns regarding wetland resources were raised during the scoping process and are included in the impact analysis:

- Direct impacts to wetlands that could result from construction of the SFN System or local development, including placement of fill into wetlands, draining of wetlands, or changes in stream elevations.

- Indirect impacts to wetlands that could result from changes in irrigation practices. These changes could result in a loss of wetland acreage or value in some areas, while increased water availability might increase the extent of wetlands in other areas.

- Creation of wetlands as a result of increases in groundwater recharge in areas that formerly did not support wetlands or that historically supported wetlands but are currently under agricultural production. In areas currently under agricultural production, increased groundwater could result in prolonged soil saturation or inundation, thereby resulting in a loss of tillable land.

- The potential for loss of wetland values as a result of increased levels of contaminants, including selenium, pesticides, and fertilizers from increased agricultural production and additional agricultural runoff into nearby wetland resources.

3.4.4 Description of Impact Area of Influence

The wetland resources impact area of influence covers approximately 148,000 acres. The northern boundary extends from just south of the shoreline of Utah Lake and includes Hobble Creek, which is located near the city of Mapleton in southern Utah County. The southern boundary is near Nephi, Utah. The western boundary occurs along the Currant Creek Canal in the Elberta/Goshen area of southern Utah County and along West Creek in

eastern Juab County. The eastern boundary includes Diamond Fork Creek from just below Mineral Springs Campground, Sixth Water Creek from the outlet of Strawberry Tunnel to Three Forks, and the Spanish Fork River (see Map 3.4-1 as well as Map 1-3). The impact area of influence for wetland resources that was defined for the "Diamond Fork Tunnel Alternative," the Main Conveyance Aqueduct and associated facilities, as well as for local development (irrigation, on-farm, and M&I distribution systems) are shown in Table 3.4-1.

3.4.5 Affected Environment

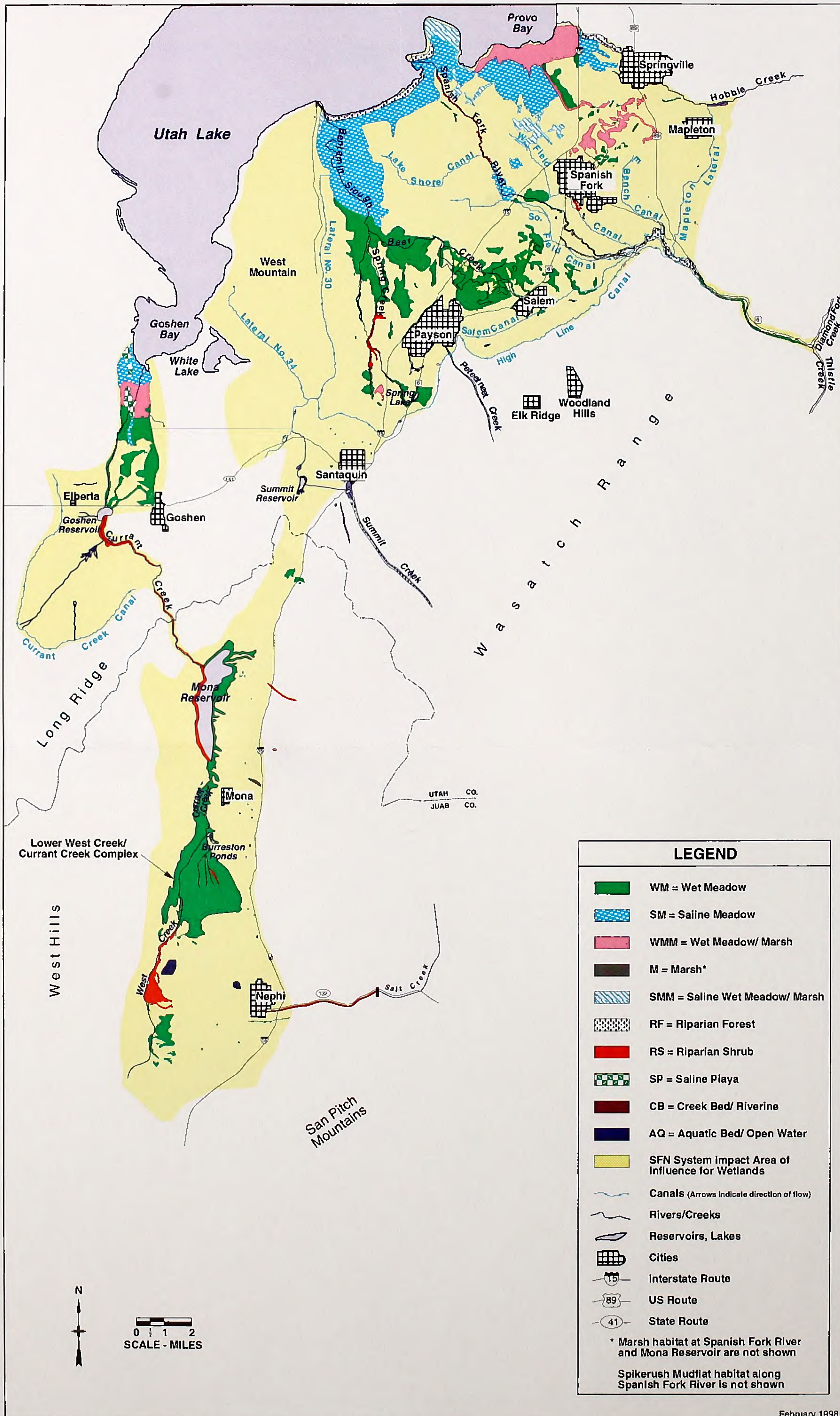
For purposes of this study, wetlands were classified according to primary vegetation type and hydrologic characteristics. The classification system generally follows the community designations used in a previous study of wetlands in the Utah Lake area performed by Brotherson and Evenson (1982). The wetland boundaries were mapped on infrared photos and plotted using a computer-aided drawing and design (CADD) system. Field work was performed to ground truth the existing mapped wetland boundaries and to collect additional data. The majority of the field work was performed in the spring and summer of 1994, with additional field work performed in December 1994, June 1995, and March 1996. A limited amount of field work was conducted in 1997 to characterize the communities present in the Diamond Fork drainage for the Proposed Action and MCAPW-DFT Alternative. The wetlands were mapped using existing information available from direct field observations, from information included in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990), and from aerial photography and photographs taken in February 1997 along selected points upstream of Monks Hollow.

Eleven wetland community types would be affected by construction and operation of the SFN System. The community types and general location and boundaries of the wetlands (including creeks) are shown on Map 3.4-1, with the exception of the spikerush mudflat community type, which is located along the upper Spanish Fork River and is too small to be shown on Map 3.4-1. It should be noted that within the wetland community boundaries shown on Map 3.4-1, other habitats and cover types are present, including native and non-native upland communities, intensive agriculture, and irrigated pasture land. Wetland communities within the Diamond Fork drainage are not shown on Map 3.4-1, but are fully described within the text of this section.

3.4.5.1 Description of Community Types

The following sections describe the primary wetland community types that could be affected by the Proposed Action or alternatives and the irrigation distribution, on-farm, and M&I water distribution systems.

3.4.5.1.1 Wet Meadow. Wet meadow is the most abundant wetland community type within the impact area of influence. This community type is dominated by plant species such as toadrush (*Juncus bufonius*), wiregrass (*J. articus*), blackcreeper sedge (*Carex praegracilis*), water sedge (*C. aquatilis*), redtop (*Agrostis stolonifera*), tall fescue (*Festuca arundinacea*), and common spikerush (*Eleocharis palustris*). Many of the native plant species of the wet meadow-community type have been disturbed or modified by local irrigators to create pastures and croplands. Plants that dominated these fields are crop species or planted grasses such as smooth bromegrass (*Bromus inermis*) and intermediate wheatgrass (*Elymus hispidus*). These two species often dominate the wetter portions of pastures or fields, while species commonly associated with upland areas, such as orchard grass (*Dactylis glomerata*), red clover (*Trifolium pratense*), tall wheatgrass (*Elymus elongatus*), alfalfa (*Medicago sativa*), and timothy (*Phleum pratense*), are present in lesser amounts on drier field edges.



Map 3.4-1
Location of Wetlands
Within the SFN System Impact
Area of Influence

human activities as farming, grazing, water diversions, and irrigation techniques. Numerous plant species dominate these areas depending on the reach of the creeks, but they are often woody species such as willows, Russian olive (*Elaeagnus angustifolius*), and tamarisk.

3.4.5.1.8 Saline Playa. Playas form in old lakebeds or other shallow, usually closed depressions with poor drainage. Rainfall or runoff from adjacent areas fills the depressions and water levels decline slowly, primarily from evaporation. Affected playas located within the impact area of influence, in general, tend to be characterized by extremely high saline soils (mean soil salinity of 42,165 ppm) and very sparse vegetation. They are located near Goshen and, although not specifically shown on Map 3.4-1, also occur in scattered areas throughout the saline meadow community in the Benjamin Slough area. The number of different plant species present (i.e., species diversity) and density of plants (i.e., number of individual plants present) in saline playa tend to be low because of the prolonged ponding and, more importantly, the high salinities. Prevalent plant species are pickleweed (samphire) (*Salicornia rubra* and *S. pacifica*), allenrolfea (iodine bush or pickleweed) (*Allenrolfea occidentalis*), and suaeda (broom seepweed) (*Suaeda depressa*).

3.4.5.1.9 Creek Bed/Riverine. The creek bed/riverine community type is one of two types of open water aquatic habitat. This designation was used for stream and river systems to represent the open, typically unvegetated channel.

3.4.5.1.10 Aquatic Bed/Open Water. The aquatic bed/open water community is another type of open water aquatic habitat. The aquatic bed/open water designation was used for lakes and smaller ponds and reservoirs. This community type is characterized by one plant species, broadleaf pondweed (*Potamogeton latifolius*). Other common pond weeds include sago pondweed (jennet-leaf) (*P. pectinatus*) and widgeon grass (ditchgrass) (*Ruppia maritima*). Both of these species are widespread and tolerant of fresh to slightly brackish water conditions and are likely associated with low water-velocity spring pools, outlet sloughs, and small ponds in the impact area of influence.

3.4.5.1.11 Spikerush Mudflat. The spikerush mudflat community occurs within Spanish Fork Canyon immediately adjacent to the Spanish Fork River's normal waterline. This community type is sparsely vegetated with spikerush and, as the name implies, is inundated annually by river flows greater than 400 cfs.

3.4.5.2 Distribution of Community Types Within Impact Area of Influence

The overall distribution of the wetland community types within the impact area of influence are shown on Map 3.4-1. The following sections describe the distribution of those community types within the impact area of influence described in Table 3.4-1. The discussion of community type distributions is organized by areas that could potentially be affected by project features. For example, Spanish Fork River wetlands would be potentially affected by construction and operation of the Main Conveyance Aqueduct and are described under the Main Conveyance Aqueduct heading, whereas wetlands communities associated with West Creek and upper Currant Creek are described under Related Actions because of the potential for an increase in irrigation return flows to affect those creeks. The affected environment for Proposed Action and each of the alternatives is similar. Because a different pipeline alignment is proposed for the Main Conveyance Aqueduct within Spanish Fork Canyon under the MCATC and MCAT Alternatives, less riverine and emergent marsh wetland would be affected. Under those alternatives, the pipeline alignment would exit Spanish Fork Canyon and the Spanish Fork River area into Pole Canyon and enter a tunnel through Loafer Mountain.

3.4.5.2.1 Diamond Fork Drainage

3.4.5.2.1.1 Diamond Fork Creek. Diamond Fork Creek is a perennial waterway that has a narrow, confined channel in the upper reaches and a meandering braided channel in the lower reaches. Floodplains are not extensive within the Diamond Fork area because of the constricted canyons. For purposes of this document, wetlands

include open water creek channel, riparian, scrub-shrub, and emergent wetlands located on point bars and old oxbows in the floodplain. There are also some small springs and seeps located within the Diamond Fork Canyon area (USBR 1990).

Since 1915, flows in the creek (and in the Spanish Fork River) have been augmented for irrigation/water delivery purposes. For purposes of this analysis, baseline conditions take into account the management practices employed along Diamond Fork Creek (i.e., grazing and land management practices), and baseline flows are those that have occurred historically. It is recognized that current habitat conditions along the creek are not the same as what was historically present prior to the alteration of the creek flows and introduction of grazing and agriculture within the areas along the creek, especially along the lower reaches.

For this discussion, Diamond Fork Creek has been divided into three reaches. The upper reach (Reach 1) includes that portion of the creek from Tanner Ridge Tunnel downstream 2.5 miles to the confluence of Diamond Fork Creek and Sixth Water Creek (referred to as Three Forks). The second reach (Reach 2) extends from Three Forks approximately 2.5 miles to Monks Hollow. The third reach (Reach 3) extends from Monks Hollow to the confluence with the Spanish Fork River (9.7 miles). The area along the lower 4 miles of this third reach was formerly grazed and farmed. The physical characteristics of Reaches 2 and 3 (Diamond Fork below Three Forks) have been greatly influenced by irrigation releases from Strawberry Reservoir into Sixth Water Creek over the past 75 years, intensive grazing along the lower portion of the creek, and clearing for agriculture.

Reach 1 of Diamond Fork Creek is characterized by a steep gradient, natural steam unaffected by irrigation releases. The canyon is narrow and bordered on each side by nearly vertical rock cliffs. Riparian vegetation is dense along the creek and is considered riparian forest for this analysis. There are some small scattered areas of emergent vegetation. No well-developed floodplain is present because of the steep gradient, and floodwaters are confined by the narrow canyon walls.

Reach 2 is also within a narrow canyon area but less so than the upper reach. From Three Forks downstream, the canyon gradually widens, the creek channel gradient decreases, and the channel is more meandering. As a result, there are more well-developed floodplain areas farther downstream.

In the upper portion of Reach 3 immediately below Monks Hollow, the channel is confined within high, steep canyon walls and has a narrow valley floor, averaging 200 to 300 feet in width. Farther downstream, the valley floor is over 400 feet wide and increases to 1,000 feet in width as one proceeds downstream. In the upper portion of the reach, the channel is a single entrenched channel with low sinuosity. Farther downstream, there are a few areas with multiple channels and abandoned meanders. The last 3 miles of the creek are characterized by multiple channels, active braiding, and evidence of repeated and large lateral movements of the channel.

This lower reach of the creek includes woody and emergent wetland; however, for discussion purposes, it is categorized as riparian wetland. The riparian wetland is confined to areas immediately along both sides of the creek channel, on point bars with the braided sections of the channels, and in old oxbow cutoff channels. Species present include coyote willow, cottonwood and red-osier dogwood (on mid-elevation and high terraces), and some tamarisk. Farming within the floodplain has been terminated, and for the most part, grazing has also ended, with the exception of a few areas. The grazing is managed by the U.S. Forest Service (USFS). Overall, the lower Diamond Fork corridor lacks riparian species, age class, and spatial diversity. In particular, there is a lack of intermediate class sizes of woody riparian vegetation combined with bare cut banks. Throughout most of the lower 4 miles of stream corridor, the riparian understory is absent or severely degraded, and much of the mature cottonwood overstory has been lost as a result of farming up to the stream banks, grazing, and high prolonged annual flows that have not permitted re-establishment of the overstory.

Immediately upstream of the Highway 6 overpass over Diamond Fork Creek, there is an emergent and open water wetland adjacent to the creek channel that covers approximately 6 acres. This emergent marsh was formed as a

result of the realignment of Highway 6 following the slide at Thistle. The overpass constructed over Diamond Fork Creek acts as a berm with water backing up and ponding behind the berm.

*3.4.5.2.1.2 **Sixth Water Creek.*** Sixth Water Creek has historically been subject to annual irrigation releases made from Strawberry Reservoir for the Strawberry Valley Project. However, since 1996, when the Syar Tunnel was put into operation, no releases from Strawberry Tunnel have been made to Sixth Water Creek. Instead, irrigation flows are released from Syar Tunnel.

Upper Sixth Water Creek from the Strawberry Tunnel outlet downstream to Dip Vat Creek (a distance of approximately 1.5 miles) has a single channel that is confined within a narrow V-shaped canyon. This segment of the creek is steep and is characterized by exposed bedrock and boulder with plunge pools. Riparian vegetation is present along less than 60 percent of the channel length, and the vegetation that is present is restricted to narrow strips on boulder terraces. Isolated cottonwood stands are also present on higher terraces. The majority of the riparian vegetation is dominated by coyote willow. Isolated stands of cottonwoods occur on terraces located more than 3 feet above the high summer stream level. Generally, the riparian vegetation present can be generally characterized as coyote willow and stands of river birch with isolated cottonwood stands and older shrub and forested communities. Along the upper portion immediately below Strawberry Tunnel, the sideslopes of the channel are sparsely vegetated, unconsolidated materials.

Below Dip Vat Creek, there is an earthflow (slide) area where 40 percent of the stream is bordered by unvegetated banks. The main channel is relatively straight, but abandoned side channels exist upstream of the earthflow area. Some young and early mature cottonwood stands occur immediately downstream of Dip Vat Creek. Older cottonwood stands are present in an abandoned side channel at the hillslope base. Beginning from approximately 1.6 miles upstream from Syar Tunnel (Sixth Water Creek Aqueduct) to Syar Tunnel, the creek bottom widens slightly and supports wider riparian zones.

Along lower Sixth Water Creek, the widest riparian zones occur along the creek. Some of the riparian zones extend up to 50 to 100 feet wide; however, portions of the creek channel are narrow and constricted. Side channels are also present. The riparian community consists of willow scrub, some young cottonwoods on adjacent low terraces, and river birch along the old side channels. Also present are sagebrush, juniper (*Juniperus osteosperma*), and bitterbrush (*Purshia tridentata*).

3.4.5.2.2 Main Conveyance Aqueduct

3.4.5.2.2.1 Upper Spanish Fork River. The upper Spanish Fork River extends from the confluence of Diamond Fork Creek and the Spanish Fork River downstream to the Strawberry Diversion Dam. Wetland and riparian habitats along the upper Spanish Fork River exist in a fairly narrow corridor, confined by steep canyon slopes, Highway 6, and the tracks of the Denver and Rio Grande Western Railroad and the Utah Railroad. The upper Spanish Fork River is channelized, with little or no vegetation. The largest wetland community present, wet meadow, is within the active floodplain of the river. The wet meadow community type occurs primarily at two different elevation levels along the river: 1) on gravel bars and low elevation terraces located 0.4 to 1.3 feet above the river surface water elevation during the irrigation season (June through September) and 2) on high terraces 1.3 to 2.1 feet above the river water surface during the same period. The wet meadow community along the gravel bars and low terraces is periodically inundated by 2-year and 10-year flood events, whereas the wet meadow community occurring on high terraces requires flood flows greater than the 10-year flood for inundation.

The wet meadow community transitions into the riparian shrub community at slightly higher elevations along the upper Spanish Fork River. Half of this community is dominated by willow and half by tamarisk. Overall, the community type is located, on average, 2.3 to 3.3 feet above the summer water surface. The riparian shrub community is primarily inundated by the 10-year flood, but those portions of the community located on higher terraces are only inundated during a 20-year flood event.

In addition to these community types, another wetland community type, saline meadow, is located immediately adjacent to the active upper Spanish Fork River channel at distance marker 7,100. Small amounts of creek bed/riverine habitat are also located immediately adjacent to the river.

A small amount of spikerush mudflat community occurs along the normal waterline along point bars and is close to the late summer water surface (within 6 inches to 1 foot). The spikerush mudflat community is inundated annually by a flow of 400 to 600 cfs. Marsh community is present adjacent to the river at Cold Springs (distance marker 15,300) and is dominated by emergent vegetation (primarily cattail). The marsh community occurs in overflow channels along the river that are inundated by 0.2 and 0.5 foot of water from May through July. The marsh community in the upper Spanish Fork River is inundated annually by a flow of 360 cfs.

3.4.5.2.2.2 Lower Spanish Fork River. The lower Spanish Fork River through the lowland areas is very constricted as a result of channelization, down-cutting, and the creation of levees for flood protection. As a result, the riparian shrub community is limited primarily to the immediate channel and banks and is very sparse and discontinuous along the river. Broader, low-lying floodplains in the vicinity of I-15 (east and west sides of the highway) support more extensive stands of riparian forest, marsh, and wet meadow communities.

3.4.5.2.2.3 High Line Canal. In general, the High Line Canal supports very little riparian vegetation within the area that would encompass the Main Conveyance Aqueduct right-of-way. Existing wetlands consist of a wet meadow fringe along unlined portions of the canal averaging 1 foot or less in width on either side of the canal. Dominant fringing vegetation includes reed canary grass (*Phalaris arundinacea*), horsetail (*Equisetum* spp), hairgrass (*Deschampsia caespitosa*), foxtail barley (*Hordeum jubatum*), and hoary cress (whitetop) (*Cardaria draba*). Scattered woody vegetation adjacent to the canal consists of the upland species gambel oak (*Quercus gambelli*). In those areas where the canal is lined, bordering vegetation consists of a mixture of sagebrush, oakbrush, and agricultural fields.

3.4.5.2.2.4 Beer Creek, Spring Creek, and Benjamin Slough. Beer Creek, Spring Creek, and Benjamin Slough are low gradient, highly channelized streams that support year-round flows. Wetlands within these creeks consist mostly of modified wet meadows within the creek channels, with scattered pockets of riparian shrub. These creeks would not be affected by construction of the Main Conveyance Aqueduct, but could be affected by the operation of the Proposed Action or alternatives.

3.4.5.2.2.5 Peteetneet Creek. The wetland community that occurs within the impact area of influence along Peteetneet Creek is a narrow corridor of riparian shrub consisting of scattered dense thickets of willows, boxelder, and alder.

3.4.5.2.2.6 North Creek. North Creek is located 5 miles northeast of Mona. Vegetation along North Creek is dominated by willow and sugarbush (*Rhus trilobata*). A narrow stand of riparian shrub wetland is present along the portion of North Creek where the proposed Main Conveyance Aqueduct right-of-way would cross.

3.4.5.2.2.7 Mona Reservoir. Mona Reservoir is a shallow reservoir used to store and deliver water to the Elberta area. A large riparian shrub community occurs along the entire western edge of the reservoir. This riparian shrub community is dominated by tamarisk, with a dense tamarisk stand occurring along the southwest reservoir margins. Wet meadows and marsh communities also occur on the adjacent terraces to the east of the reservoir above the maximum water surface elevation. The terrace wet meadows and marsh are subject to spring and seep discharge and do not appear to be hydrologically connected to the reservoir.

The West Mona Pumping Plant would be located immediately downstream of the Mona Reservoir dam spillway and would be sited primarily on upland sagebrush habitat. The shoreline at this location consists of unvegetated cobbles, with wetland habitat (aquatic bed/open water) occurring only below the maximum average monthly elevation of the reservoir (4,879.2 feet in elevation).

3.4.5.2.2.8 Lower Currant Creek. Two riparian community types, riparian shrub and wet meadow, are present along lower Currant Creek from Mona Reservoir to the mouth of Goshen Canyon. Portions of the wet meadow community located on a high terrace include a mixture of grasses with upland species such as cheatgrass (*Bromus tectorum*) and sagebrush and have been identified as a separate community subtype.

3.4.5.2.3 Related Actions (Local Development)

3.4.5.2.3.1 M&I Water Distribution. Existing water distribution facilities would be modified and/or constructed by communities receiving M&I water in southern Utah County. As described in Section 1.9.2.1, specific plans for the development of secondary systems in eligible communities are not available at this time; however, estimates of existing wetland habitat used an M&I Representative Area Template (see Appendix C, *Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template*). Within the M&I Representative Area Template, two wetland community types, riparian shrub and wet meadow, are present within the unlined ditches.

3.4.5.2.3.2 Irrigation Distribution System. Four existing distribution canals in southern Utah County (Mapleton, Salem, South Field, and Lateral 20) would be modified as a consequence of the Proposed Action. The wetlands within these canals are comprised predominantly of a narrow fringe of riparian shrub, riparian forest, and wet meadow. Within the areas eligible to receive water, riparian shrub and wet meadow/marsh wetlands occur within and along the existing primary irrigation ditches and could be affected by proposed improvements. A new distribution pipeline (SU7) would be constructed along the southern edge of the town of Santaquin. No existing canal replacement or elimination would be required for construction of Turnout SU7.

3.4.5.2.3.3 West Mona Distribution Pipeline. The West Mona distribution pipeline would begin at the West Mona Regulating Pond and be constructed within an area currently under agricultural production. No existing canal system would be replaced.

3.4.5.2.3.4 Currant Creek Distribution Pipeline. The Currant Creek distribution pipeline would be constructed from the existing diversion structure on Currant Creek and terminate downstream at the Currant Creek Canal. It would replace an existing irrigation channel and pipeline, but the existing channel, which supports a riparian shrub community along its banks, would remain intact.

3.4.5.2.3.5 East Juab Water Efficiency Project. Wetland habitat present within the existing irrigation canal system located within the EJWEP is primarily limited to a small amount of riparian shrub wetland along some of the irrigation canals. The majority of the riparian shrub is found along the primary irrigation distribution ditch located along the railroad tracks west of Nephi; the ditch conveys flows from Salt Creek to irrigation lands to the west. This riparian shrub habitat is limited to a narrow band of willow and Wood's rose (*Rosa woodsii*) 3 to 5 feet in width along each channel bank. The remaining irrigation channels that convey water to the lands west of Nephi are maintained irrigation ditches, 2 to 3 feet in width and roughly 2 feet in depth, many of which are concrete-lined. The vegetation adjacent to those ditches is primarily Wood's rose and upland grasses. The few unlined irrigation ditches present are routinely excavated by the landowners to remove vegetation and sediment to allow efficient delivery of water. The wetland habitat associated with Salt Creek is discussed in Section 3.4.5.2.3.7 as part of the discussion of Salt Creek facilities.

3.4.5.2.3.6 North and South Nephi Distribution Systems. Wetland habitat located along the North and South Nephi Distribution Systems is limited to a fringe of riparian shrub along portions of 5 miles of existing unlined irrigation ditch.

3.4.5.2.3.7 Salt Creek Facilities. Two distinctly different reaches comprise the portion of Salt Creek within the impact area of influence. The upper reach extends approximately 1 mile from the proposed Salt Creek Diversion Dam site (described in Section 1.9.3.1.1) downstream to the mouth of Salt Creek Canyon and is characterized by

a slightly meandering stream. The riparian wetland in this area is typically 30 to 50 feet wide (including the active channel) and is dominated by coyote willow and narrowleaf cottonwood saplings. Scattered tamarisk also occurs. The riparian communities in the upper reach of Salt Creek are within 3.3 feet of the creek water surface during May, but remain above this level for the rest of the growing season. Immediately below the Salt Creek Diversion Dam site, the floodplain expands up to 300 feet wide for a short distance, with a mixture of willows and wet meadow vegetation. High cut banks (10 to 15 feet) are evident throughout this area, and in those locations where the channel narrows, a sagebrush-willow mixture dominates the adjacent banks. Below the mouth of Salt Creek Canyon, the stream has been channelized and the riparian width narrows to approximately 10 feet or less on either side of the channel. This lower, channelized section extends approximately 2 miles to the west side of Nephi. The riparian communities in the lower section occur within 1.2 to 2 feet above the creek water surface during the growing season.

The Nephi Pumping Plant would be located along the lower portion of Salt Creek that supports a narrow fringe of riparian forest (extending no more than 15 to 20 feet from the channel). The trees present include narrowleaf cottonwood and black locust (*Robinia pseudoacacia*), and shrubs include coyote willow and Wood's rose.

3.4.5.2.3.8 On-Farm System Areas. Three geographic areas that support wetland habitat within the impact area of influence could be affected by return flows or changes in groundwater discharge or recharge. These wetlands are located at a lower elevation than the lands eligible to receive water. These areas include wetlands within southern Utah County, the Elberta/Goshen Valley area, and eastern Juab County. The wetland community types and acreages within each of the three areas are summarized in Table 3.4-2. Impacts to these wetlands are described in Section 3.4.6.3.3, Related Actions (Local Development).

Table 3.4-2
Distribution and Areas of Wetland Community Types in the On-Farm System Areas

Community Type*	Area (acres)		
	Southern Utah County	Elberta/Goshen Valley	Eastern Juab County
Wet meadow	8,288	1,528	5,830
Saline meadow	9,276	818	0
Wet meadow/marsh*	2,899	577	7
Marsh	0	0	31
Saline wet meadow/marsh*	1,294	0	15
Riparian forest	2,160	0	0
Riparian shrub	338	246	538
Saline playa	0	249	0
Creek bed/riverine	38	0	0
Aquatic bed/open water	135	0	1,530
Total	**24,428**	**3,481**	**7,951**

*Note: No spikerush/mudflat community type occurs within the on-farm areas.

Southern Utah County. Within the impact area of influence in southern Utah County, 24,428 acres of wetlands are present at a lower elevation than the areas eligible to receive water that could be affected by return flows from irrigated areas or by changes in groundwater hydrology. This wetland acreage is in addition to the wetland acreage associated with the previously discussed wetlands within the right-of-way of the Main Conveyance Aqueduct or the local distribution canals. The predominant community types are wet and saline meadows. Most of the wet meadows are used primarily for flood irrigation and pastures, but in some cases, they are used for agricultural row crop production (beets, small grains, and corn).

Elberta/Goshen Valley. The Elberta area within the impact area of influence is underlain by well-drained soils and contains few wetlands. The 246 acres of wetlands in the Elberta area are limited to narrow riparian shrub communities located along lower Currant Creek, drainage canals, and borders of artificial ponds. Lower Currant Creek delivers water to the Elberta area, where it enters Goshen Reservoir just southwest of the town of Goshen. Below the reservoir, lower Currant Creek is split into two canals. Just north of this split, 818 acres of saline meadow and 1,528 acres of wet meadow are present. An additional 577 acres of wet meadow/marsh are also present.

Eastern Juab County. The portion of eastern Juab County that is located at a lower elevation than the areas eligible to receive water lies within Juab Valley, This valley is relatively long and narrow valley (typically 3 to 5 miles wide and about 15 miles long). Two main streams (Currant and West Creeks) drain the valley, with flows collected in Mona Reservoir. The upper portion of West Creek is bordered by a riparian shrub community. Wetlands associated with the middle portion of West Creek and the headwaters of upper Currant Creek join to form a broad expanse of spring-fed, interspersed marsh and wet meadow communities. This wetland area, herein referred to as the West Creek/Currant Creek complex, exhibits a general trend of increasing wetness and decreasing salinity from south (upstream) to north (downstream) and west to east; that is, the wetlands in the northern and eastern sides of the valley tend to be wetter and less saline than those on the western and southern end of the complex. The wetlands northeast of the community of Mona are supported by seeps and springs that discharge along the terrace slopes above the main valley floor. Topography in this complex is typically steeper than most other wetland areas in the impact area of influence. Riparian communities along West and Currant Creeks were generally too narrow (less than 30 feet wide) to show on Map 3.4-1.

3.4.6 Impact Analysis

3.4.6.1 Significance Criteria

Potential impacts to wetland resources would be considered significant if any one of the following conditions occurred:

- Any wetland acreage would be permanently lost through fill
- Changes in the quality or quantity of wetland hydrologic support would result in an overall loss or gain of wetland acreage
- Changes in the quality or quantity of wetland hydrologic support would result in the conversion of vegetated wetland community type to a non-vegetated community type or an upland habitat

These significance criteria were developed as part of the scoping process for this DEIS and through input provided by concerned agencies. They are based upon regulatory and agency policies specifying "no net loss" of wetland acreage or functions and values. Losses of wetland functions and values are addressed by assessing changes in wetland community types.

Non-vegetated wetland community types included creek bed/riverine and aquatic bed/open water. Although aquatic bed/open water can support vegetation, the presence of vegetation is dependent on suitable growth factors (e.g., depth of inundation and moderate water level fluctuation). Therefore, the conversion of a vegetated community type to non-vegetated wetland community type is considered significant if suitable conditions do not exist that would allow the establishment of aquatic vegetation.

3.4.6.2 Potential Impacts Eliminated from Further Analysis

Impacts associated with construction and operation of the recreation trail in southern Utah County were eliminated from further analysis. Since the recreation trail would be constructed within the right-of-way of the Main Conveyance Aqueduct, no additional impacts would be associated with construction and operation of the trail beyond those identified for the Main Conveyance Aqueduct.

3.4.6.3 Proposed Action

The following sections describe the construction- and operation-related impacts resulting from the Proposed Action. These impacts are summarized in Section 3.4.6.10.

3.4.6.3.1 "Diamond Fork Tunnel Alternative"

3.4.6.3.1.1 Construction Impacts. Construction of the "Diamond Fork Tunnel Alternative," including access road construction or improvement, would require a total of nine crossings of several water bodies within the Diamond Fork drainage area. Construction activities would require some fill placement into intermittent drainages. The construction impacts described below are summarized in Table 3.4-3.

Tanner Ridge Tunnel–Sixth Water Creek Crossing. One crossing over Sixth Water Creek would be required to connect the outlet of Sixth Water Aqueduct to the proposed Tanner Ridge Tunnel inlet via a connecting pipeline under Sixth Water Creek. The location of the crossing would be at the existing outlet of Syar Tunnel. The creek channel in this location was disturbed when Syar Tunnel was constructed.

The 660 cfs connecting pipe would be 500 feet long and 96 inches in diameter. The pipe would be placed in an open trench crossing Sixth Water Creek; the trench would then be filled and the creek channel restored to existing grade. It is estimated that 0.3 acre of creek bed/riverine habitat would be temporarily disturbed. There is no adjacent wetland habitat. No permanent disturbance to the creek would result since the channel would be restored to pre-construction conditions.

The Tanner Ridge Tunnel inlet site is accessible via an existing unpaved maintenance road from the paved Rays Valley Road on Strawberry Ridge to the outlet of the existing Sixth Water Aqueduct. Improvements to the existing access road would not result in impacts to wetlands. A short extension of this road would be required to access the inlet portal of Tanner Ridge Tunnel. A bridge across Sixth Water Creek would be required, but would not affect wetlands because of previous disturbance in the area.

Table 3.4-3
Wetland Type and Acreage Loss Resulting from Construction of the Proposed Action and MCAPW-DFT Alternative

Community Type	Location	Approximate Distance Marker (ft)	Temporary Disturbance[a] (acres)	Permanent Disturbance[b] (acres)
"Diamond Fork Tunnel Alternative"				
Riparian Shrub	Diamond Fork Creek crossings	NA	0.20	0.00
	Sixth Water Creek crossings	NA	0.30	0.00
	Tanner Ridge Tunnel; unnamed drainage	NA	0.00	0.00
Creek Bed/Riverine	Diamond Fork Siphon and Red Hollow Tunnel inlet; Diamond Fork Creek crossing	NA	0.01	0.00
	Red Hollow Drainage crossing	NA	0.10	0.00
Subtotal			**0.61**	**0.00**
Main Conveyance Aqueduct				
Riparian Shrub	Spanish Fork Canyon (seep)	1,680; 2,000	0.01	0.00
	Peteetneet Creek	77,500	1.14	0.00
	North Creek	145,200	0.93	0.00
Creek Bed/Riverine	Spanish Fork River	26,800	0.23	0.00
Saline Meadow	Spanish Fork Canyon	7,100	0.00	0.00
Marsh	Spanish Fork Canyon	15,300	0.01	0.00
Aquatic Bed/Open Water	High Line Canal	45,000-80,000	0.00	0.24
	West Mona facilities	NA	0.00	1.00
Wet Meadow	2 miles north of Mona	NA	0.22	0.00
Subtotal			**2.54**	**1.24**
Total			**3.2[c]**	**1.2[c]**

[a]Temporary disturbance means that the wetland area would be restored to its pre-disturbance condition within 5 years.
[b]Permanent disturbance represents wetlands lost through fill or facility siting.
[c]Rounded to nearest tenth.

Tanner Ridge Tunnel–Unnamed Drainage Crossings. Construction access to the Tanner Ridge Tunnel outlet would be via the newly constructed section of Diamond Fork Canyon Road to the end of the existing Diamond Fork Pipeline, then by an older, narrower section of that road above Monks Hollow. From upper Diamond Fork Canyon Road near the outlet, a new access road would be cut into the sidehill terrain of upper Diamond Fork Canyon for access to the Tanner Ridge Tunnel outlet. The new access road to the Tanner Ridge Tunnel Outlet would require four crossings of an unnamed drainage that only flows during snowmelt and rainstorms. The drainage varies in size between 2 and 4 feet in width and supports no adjacent wetland communities. Outside the active drainage, the vegetation consists of upland species of sagebrush, rabbitbrush (*Chrysothamnus* sp.), and oak. Several intermittent seeps are also present along the drainage, but none support permanent flow and would be

avoided during construction. Therefore, no loss of wetlands would result from construction of the Tanner Ridge Tunnel outlet access road.

Excavation of the Tanner Ridge Tunnel outlet would produce an estimated 29,000 cubic yards of rock waste material. This material would be deposited near the outlet portal in an upland area on the west side of Tanner Ridge and positioned for stability to prevent erosion into the drainage and would not affect any wetlands.

Diamond Fork Siphon–Unnamed Drainage and Diamond Fork Creek Crossings. The Diamond Fork Siphon would connect the Tanner Ridge Tunnel outlet to the Red Mountain Tunnel inlet. Construction of the siphon would require one crossing of the unnamed drainage discussed above and one crossing of Diamond Fork Creek. The Diamond Fork Siphon would be constructed parallel to Diamond Fork Creek for a distance of 2,300 feet before crossing over Diamond Fork Creek. The siphon would be constructed outside the creek and riparian area except where it crosses over the creek. The creek channel is approximately 8 feet wide at the crossing and the riparian habitat extends approximately 10 feet on both sides of the creek. The creek crossing would require excavation and riparian vegetation removal within a 100-foot-wide right-of-way section of the creek. The creek would be restored to pre-construction grade and revegetated with riparian species. The total temporary disturbance would be 0.01 acre of creek bed/riverine and 0.2 acre of riparian habitat.

Red Mountain Tunnel Inlet–Access Road Crossing over Diamond Fork Creek. A span bridge would be constructed over Diamond Fork Creek to provide access to the Red Mountain Tunnel inlet. The span bridge would be in the same location as the Diamond Fork Siphon crossing and would be designed to span the width of the creek and riparian corridor. No temporary or permanent wetland impacts would result from this span bridge construction.

Red Hollow Pipeline–Access Road and Crossing over Red Hollow Drainage. Construction of the Red Hollow Pipeline access road would require some limited improvements to the first 2.5 miles of the existing unpaved truck road from the confluence with Diamond Fork Creek up Red Hollow. The improvements would require widening a particularly narrow area above the Red Hollow drainage; however, no fill placement into the Red Hollow drainage would be required.

Construction of the Red Hollow Pipeline would require one crossing over the Red Hollow drainage upstream from the access road improvement area discussed above. The channel at the crossing is 2 feet wide, and no riparian habitat is present. The total amount of temporary disturbance that would result to wetlands (creek bed/riverine) at the crossing would be 0.1 acre.

3.4.6.3.1.2 Operation Impacts

Diamond Fork Creek Above Three Forks (Reach 1). No operational impacts would occur from the Proposed Action in this reach of Diamond Fork Creek since no flow changes would occur and annual maintenance would not require disturbance of any wetland habitat.

Diamond Fork Creek Below Three Forks (Reaches 2 and 3). As a result of the operation of the Proposed Action, flows within Diamond Fork Creek below Three Forks would substantially decrease compared to baseline flows. Under baseline conditions, the mean monthly flows below Three Forks and below Monks Hollow range from 12 cfs to 293 cfs, with the peak flows occurring from June through August as a result of irrigation releases from Strawberry Reservoir. As a result of these high prolonged flows, the channel is braided and the riparian community is composed primarily of older age class individuals of cottonwood and willows. Under baseline conditions, it is difficult for intermediate size classes of woody riparian species to mature because of continual channel migration and instability.

Under the Proposed Action, the mean monthly flows would range from 37 cfs to 139 cfs between Three Forks and Monks Hollow, and the mean monthly flows below Monks Hollow would range from 60 cfs to 144 cfs for the 44-year period of record (i.e., historic). The peak flows would occur during April, May, and June. Peak flows of 244 cfs and 395 cfs would occur in April and May along both reaches in 1 year out of every 44 years. During wet year conditions, a decrease in peak irrigation releases would still occur from April through September but to a lesser degree (decrease ranging from 45 cfs to 125 cfs). There would be a slight increase in the peak irrigation release in May under dry year conditions (from 363 cfs to 395 cfs). During dry years, the flows from September through April would increase slightly, but the peak irrigation releases would decrease from May through August (decrease ranging from 16 cfs to 228 cfs).

Under the Proposed Action, it is predicted that, over time, the Diamond Fork Creek channel, in particular in the lower 4 miles, would stabilize and become less braided, eventually moving toward forming a single meandering channel as a result of more stable flows. Under these conditions, new creek side banks would form and riparian species would gradually establish along the creek banks under dry year conditions; however, the peak irrigation releases may hinder recolonization. The species expected to establish naturally (e.g., coyote willow and tamarisk) would be those that can easily colonize and outcompete other species. Some native species, such as cottonwood, could establish naturally but to a lesser extent than the more aggressive non-native species. In order to promote establishment of native species, future management plans by land management agencies could include planting and/or fencing to protect seedlings from grazing and flow modification to promote natural establishment and eradication of invasive species such as tamarisk. The SFN System has been designed to provide flexibility in the water delivery/hydrologic regime so that land management agencies could design and implement riparian establishment/management plans in accordance with their management goals to the extent that they do not interfere with downstream water users.

Upper Sixth Water Creek (Above Syar Tunnel). As a result of operation of the Proposed Action, increased releases from Strawberry Tunnel over baseline conditions would occur. These releases would be greater than current releases (i.e., post-1995 conditions when Syar Tunnel was put into operation), but less than the historic (baseline) releases made prior to operation of the Syar Tunnel. The mean average flow would increase from a range of 7 to 20 cfs from October through April, but during the irrigation season (i.e., from May through September), the mean average flow would decrease from a range of 39 to 238 cfs. The peak decrease would occur during July (decrease of 238 cfs over historic). During wet years, the decreases would be less pronounced since smaller irrigation releases would need to be provided to downstream water users. During dry years, the decrease in flows over historic conditions would be even more pronounced and would range from 48 cfs to 276 cfs. During mean, dry, and wet years, the timing of the peak releases would remain unchanged from historic conditions.

The hydraulic regime in upper Sixth Water Creek under the Proposed Action would provide more stable flows. As a result, it is expected that the existing riparian community would re-establish at a slightly lower elevation, depending on substrate conditions; a substantial part of the substrate adjacent to the channel is boulders. No loss of wetland habitat along this section of the creek would occur, and an unquantified amount of riparian community would be re-established over a period of time.

Lower Sixth Water Creek (Below Syar Tunnel). Under the Proposed Action, flows in lower Sixth Water Creek would increase slightly from October to April, but from May through September, the average mean flow would decrease since the irrigation releases would no longer be conveyed though lower Sixth Water Creek. These increases and decreases would also occur under wet year conditions, but to a lesser extent. During dry years, the flows would increase by approximately 20 cfs from October through April and would decrease from May through September by 2 to 276 cfs.

On average, flows within lower Sixth Water Creek under the Proposed Action would be lower and more stable than under historic conditions. As a result, the riparian community is expected to re-establish at a slightly lower elevation with no permanent loss of wetland habitat anticipated.

3.4.6.3.2 Main Conveyance Aqueduct

3.4.6.3.2.1 Construction Impacts. The impact on wetland communities as a result of construction and operation of the Proposed Action is summarized in Table 3.4-3. The Main Conveyance Aqueduct would cross riparian shrub wetlands at the Spanish Fork River, Peteetneet Creek, and North Creek. The crossings would be made using the open trench method described in Chapter 1 and in accordance with the procedures outlined in Appendix A, *Erosion Control, Revegetation, and Maintenance Plan*, and Appendix B, *Standard Operating Procedures*. The entire area would be restored, the topsoil would be replaced, and all pre-disturbance contours restored. Similar handling of topsoil would occur in those areas where wet meadow and emergent marsh wetlands are crossed. It is anticipated that the original riparian or wetland communities would re-establish within 1 to 3 years for herbaceous communities and within 3 to 5 years for riparian shrub communities. Therefore, these temporary disturbances would not result in a significant impact since the areas would be restored within 3 to 5 years. No additional wetlands would be affected by construction of the recreation trail. There would be a total of 2.5 acres of temporary disturbance to wetland communities from construction of the Main Conveyance Aqueduct.

A permanent loss of 1.24 acres of wetlands through the placement of fill materials (i.e., fill dirt or permanent structures) would also result from the Proposed Action. Included in this total is a loss of 0.24 acre of aquatic bed/ open water community that would result from placement of the pipeline within the existing High Line Canal and a loss of 1.0 acre of aquatic bed/open water community that would result from construction of the West Mona Pumping Plant inlet structure. This permanent loss of wetland as a result of fill placement would be a significant impact.

No impacts to wetland resources would result from the construction of the four spur lines extending from Turnouts EJ1 through EJ4, turnouts, regulating ponds, power line and access road, equalization reservoirs, or the Main Conveyance Reservoir because they are not located in any wetland areas.

3.4.6.3.2.2 Operation Impacts. As described in Section 3.2, Water Resources, operation of the Main Conveyance Aqueduct under the Proposed Action would result in changes in the amount of flow and the flow patterns within the impact area of influence. In particular, changes in the amount and timing of flows, as compared to baseline conditions, would occur in the upper Spanish Fork River, Mona Reservoir, and lower Currant Creek as a result of conveying water through the Main Conveyance Aqueduct and related facilities, including releases from Mona Reservoir. The type and amount of wetlands present along these streams are closely tied to hydrologic conditions. In particular, the specific community type present (e.g., riparian shrub, marsh, or wet meadows/marsh) is primarily a function of the amount, timing, and duration of surface and subsurface inundation of these communities, commonly referred to as the "hydrologic regime." Changes in the hydrologic regime can result in the direct loss of wetland habitat from scouring by high flows, or the changes can cause conversion from one wetland community type to another that is better adapted to a different hydrologic regime.

As a result of the Proposed Action, average monthly flows in the upper Spanish Fork River would decrease from baseline conditions from May through September. However, flows during the winter months (i.e., October to April) would remain at fairly constant levels between 114 to 267 cfs, which are slightly higher than baseline conditions (see Section 3.2). The 2-year flood event would remain similar to baseline conditions (600 versus 610 cfs), but the magnitude of the 10-year flood would be reduced from 1,250 to 1,100 cfs.

Permanent loss of wetland habitat through conversion of vegetated wetlands to non-vegetated wetland or upland habitat would result from operation of the Main Conveyance Aqueduct. In addition, changes to wetland communities would occur as a result of operation of the Main Conveyance Aqueduct, but would be limited to shifts in the vegetated community type. These shifts in community types resulting from changes in average monthly flows, flood frequencies, and water surface elevation within the water bodies affected by operation of the SFN System (i.e., the upper Spanish Fork River and lower Currant Creek) are summarized in Table 3.4-4. Following is a discussion of each of the wetlands impacts shown in the table.

Table 3.4-4
Wetland Community Changes Predicted to Result from Operation of the Proposed Action Main Conveyance Aqueduct[a]

Location	Community Type	Predicted Community Type Change	Acres Converted
Significant Wetland Community Changes (Conversion to a Non-Vegetated Community Type)			
Lower Currant Creek	Riparian shrub	Creek bed/riverine	0.9
Total Acres of Significant Wetland Community Change			**0.9**
Non-Significant Wetland Community Changes (Conversion to Another Vegetated Wetland Community Type)			
Upper Spanish Fork River	Spikerush mudflat	Conversion to wet meadow	1.5
	Wet meadow	High terrace wet meadow conversion to riparian shrub	1.1[b]
Total Acres of Non-Significant Wetland Community Change			**2.6**

[a]No adverse wetland impacts would result from operation of the "Diamond Fork Tunnel Alternative."
[b]Some unquantifiable downslope migration into new seasonal drawdown zone likely.

Lower Currant Creek. As part of the operation of the Proposed Action, water would be released from Mona Reservoir to lower Currant Creek and a portion of the water would be diverted into the Currant Creek distribution pipeline for delivery to the Elberta area. Flows within lower Currant Creek above the Currant Creek Diversion would increase by an annual average of approximately 55 percent, ranging from 5 to 24 cfs. From May through August, the increase in flows would range from 9 to 24 cfs. The peak flow in the channel would be 69 cfs in May.

Below the diversion, the annual average flows would increase by a range of 4 to 28 cfs, with the peak historical flow of 25 cfs in May increasing to 38 cfs as a result of the operation of the Proposed Action. These increases in flow both above and below the diversion are not expected to result in substantial changes in the wetland communities bordering the creek. Immediately below Mona Dam, it is predicted that initially there would be a loss of 0.30 acre of riparian shrub as a result of increased erosion and a higher surface water elevation. The existing riparian community would be subject to prolonged inundation.

The slightly higher and more stable flow regime may serve to promote expansion of riparian habitat in areas that are currently subject to wide shifts in available water because of flow fluctuation. Below the diversion, an estimated additional 0.6 acre of riparian shrub habitat would be lost as a result of increased flow causing sidebank erosion and a higher surface water level. In total, 0.9 acre of riparian shrub would be lost. No loss is expected as a result of the slightly higher surface water elevation.

As described in Chapter 1, Section 1.9.3.2, the existing Currant Creek Irrigation District canal/pipeline would be used to help increase the amount of riparian habitat located between the channel and pipeline and Currant Creek by maintaining flow in the channel and pipeline. Currently, portions of the channel and pipeline leak, and the bank immediately downslope of the leaks support willow and other wetland plants. By creating additional leaks in the channel and pipeline, it is predicted that an additional 1.1 acres of riparian shrub habitat would be created, more than offsetting the predicted loss of 0.9 acre of riparian shrub as a result of bank erosion.

Upper Spanish Fork River. Along the upper Spanish Fork River, some wet meadow and spikerush mudflat communities would likely convert to another vegetated wetland community type as a result of increased

streamflows during the non-irrigation season; however, no permanent loss of vegetated wetland would occur. The impact on marsh habitat would be minimal since the marsh habitat would continue to be shallowly inundated or saturated within 6 inches of the soil surface. The water table within the low terrace wet meadow communities would remain high enough throughout the irrigation season to support this wetland community, resulting in no change to the wet meadows. However, wet meadows occurring on higher terrace elevations would likely convert to 1.1 acres of riparian shrub community because of a decrease in the amount of groundwater inundation/saturation at the high terrace elevations. The habitat occupied by 1.5 acres of spikerush mudflat community along the upper Spanish Fork River would likely convert to wet meadow community because the community would no longer be inundated and the amount of subsurface inundation would decrease during the primary growth period of the wetland vegetation (i.e., early spring through early summer).

No change is predicted for the riparian shrub community along the upper Spanish Fork River since the water table would remain fairly stable and the decrease in the magnitude of the 10-year flood flow is not a substantial change from baseline conditions. The timing of the flood flows also would not change from baseline; therefore, the existing riparian shrub communities would not be adversely affected.

Mona Reservoir. As a result of the Proposed Action, the average peak water surface elevations of Mona Reservoir would occur in March and April, similar to baseline conditions, but the average water surface elevation would be approximately 2.5 feet higher. However, the range (or extremes) of reservoir levels would be the same with the Proposed Action, but the number of months that experience the extremes would increase. This would result in raising the average March and April surface water elevations. During July and August, the average surface elevation would be 1.6 to 1.7 feet lower than baseline conditions. The increase in the average surface elevation in March and April and the decrease in average surface elevation in July and August would not impact any of the existing wetland communities within the reservoir since these communities are subject to both higher and lower surface water elevations under current conditions and tolerate these types of fluctuations.

Higher water levels in the spring could possibly increase the amount of tamarisk within the riparian shrub community located along the western and southwestern edges of the reservoir; however, expansion of tamarisk within this wetland area would likely continue regardless of the implementation of the Proposed Action. The wet meadow communities located at the points at which tributary inflows enter Mona Reservoir would not be adversely affected by the changes in reservoir operation because these wetlands depend on stream inflow and not on reservoir water surface elevation for water.

3.4.6.3.3 Related Actions (Local Development). Impacts to wetland resources from the construction and operation of the distribution, on-farm, and M&I distribution systems under the Proposed Action are considered below. Construction of these systems and the ultimate water application (or the change in the hydrologic regime) from these systems has the potential to impact wetland resources.

3.4.6.3.3.1 Construction Impacts. All wetland vegetation bordering the four existing distribution canals in southern Utah County and the primary on-farm ditches in the Mona-Nephi area would be permanently lost as a result of the replacement of the canals with pipeline or their abandonment. Wetland types and acreages permanently removed as a result of distribution pipeline construction within the existing canals are shown in Table 3.4-5.

Salt Creek Facilities. Construction of the Salt Creek facilities would require installation of 1.5 miles of new pipeline to connect the Salt Creek Diversion Dam and the Main Conveyance Aqueduct equalization reservoir. No pool would be created behind the Salt Creek Diversion Dam, and therefore, no riparian vegetation would be inundated. However, construction of the diversion dam would require removal of riparian habitat and some creek bed/riverine habitat within the footprint of the dam. The Nephi Pumping Plant inlet structure would extend into the narrow strip of riparian and creek bed/riverine habitat and would affect an area approximately 180 feet in

length and 10 feet in width. In total, construction of the Salt Creek facilities would result in the permanent loss of 0.62 acre of riparian shrub and 0.02 acre of creek bed/riverine habitat (see Table 3.4-5).

Table 3.4-5
Wetland Type and Acreage Permanently Removed by Construction and Operation of Related Actions Under the Proposed Action and MCAP Alternative

Community Type	Location	Total Wetland Acres Lost[a]
Wet meadow	Mapleton Distribution Pipeline	2.80
Riparian shrub	Mapleton Distribution Pipeline	2.80
	South Field Distribution Pipeline	1.20
	Salem Distribution Pipeline	1.17
	Lateral 20 Distribution Pipeline	2.90
	Currant Creek Pipeline	0.06
	Salt Creek Facilities	0.64
	Salt Creek (Operation)	2.50
Creek bed/riverine	Salt Creek Facilities	0.02
Riparian shrub/wet meadow[b]	Nephi/Eastern Juab County primary ditches[c]	1.20[d]
Subtotal		**15.3**
Riparian shrub/wet meadow[b]	M&I Distribution System	6.40
Total		**21.7**

[a]Acreage based on widths of 5 and 10 feet.
[b]This classification represents a combination of two intermixed community types. A breakdown of acreage between the two community types was not possible.
[c]Includes North and South Nephi Distribution Systems and the EJWEP distribution system.
[d]Includes the loss of 0.9 acre of riparian shrub that will result when the EJWEP is constructed prior to the Main Conveyance Aqueduct.

Irrigation Distribution Systems. Along the Mapleton Distribution Canal, riparian shrub and wet meadow would be permanently removed; along Lateral 20, riparian shrub would be removed; along the South Field Canal, a combination of riparian shrub and riparian forest wetland would be removed; and riparian shrub along the Salem Canal and the Currant Creek Pipeline would be removed. No wetland loss would result from construction of the SU7 distribution pipeline or the West Mona Pipeline. The amount of permanent wetland loss for each distribution pipeline is shown in Table 3.4-5.

Nephi Distribution Systems/East Juab Water Efficiency Project. Construction of these water distribution systems near Nephi would require elimination or excavation of a total of 24.2 miles (19.2 miles of canal within the EJWEP area and 5 miles within the North Nephi and South Nephi Distribution Systems) of existing lined and unlined irrigation channels. This would result in the loss of approximately 1.2 acres of riparian vegetation (based on an average width of 4 feet and 10 percent of each mile of ditch supporting riparian habitat).

M&I Distribution System. Construction of the M&I distribution system would result in the conversion of 6.4 acres of riparian shrub and wet meadow communities to upland habitat. These wetlands border the currently unlined irrigation ditches. The amount of wetland that would be converted to upland habitat was determined using the M&I template (see Appendix C, *Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template*).

3.4.6.3.3.2 Operation Impacts. Operation of the local distribution and on-farm systems could adversely affect wetland habitats downgradient of the agricultural areas eligible to receive water conveyed by the SFN System. The wetland impacts could result from increased or decreased groundwater discharge since the presence of many of the wetlands within the areas downgradient of the on-farm areas depends upon the availability of shallow groundwater or point and non-point discharges from springs. In addition, changes in groundwater or surface water return flow quality (i.e., increased salinity) could also adversely affect the existing wetland communities. A decrease in groundwater discharge could result in conversion of a particular wetland community type to another wetland community type or to upland habitat. Increases in groundwater discharge could also result in wetland community type conversion or the creation of wetland habitat in new areas. The following discussion describes the impacts resulting from changes in groundwater discharge to wetland communities within the three geographic locations where wetlands could be adversely impacted by operation of the distribution and on-farm systems.

Salt Creek. As a result of the Proposed Action, average monthly flows in Salt Creek would be reduced in May and June, with smaller reductions in April, July, August, and September. During the remainder of the year, the average monthly flows would be similar to baseline conditions. The hydrologic regime would remain similar to baseline conditions, with the exception that the water table supporting the upper reach of the riparian shrub community below the proposed diversion dam would be 1.2 feet lower during the early irrigation season. This, coupled with reduced flows in May and June, would likely result in a conversion to upland habitat of 2.5 acres of the riparian shrub community located outside the active channel (see Table 3.4-5). Based on the significance criteria, this impact would be significant. No changes in the wetland habitat downstream of this reach of the creek would occur as a result of operation of the SFN System.

Southern Utah County. As a result of the local development changes caused by the Proposed Action, average annual groundwater levels and discharges from springs would increase in southern Utah County under average conditions. The increased discharge would occur primarily in existing discharge areas (i.e., springs), although the timing of discharge would not change from existing conditions. The spring flows would increase by about 7 percent. The primary impact of the increased spring discharges would be 1) to increase streamflows within the streams draining southern Utah County and 2) to increase the streamflow input to Utah Lake.

As discussed in Section 1.9.2.1, under the Proposed Action, various cities would pump groundwater to develop the Bonneville Unit M&I water for which they contract. However, the specific locations at which these cities would pump groundwater are not known at this time. The groundwater pumping could occur at existing or new facilities or at locations dependent upon growth patterns and future water system planning of individual cities. Since the ultimate effect of this pumping cannot be evaluated until these locations are determined, the potential impacts of M&I groundwater pumping on wetland resources are not included in this DEIS. Additional NEPA compliance would be necessary when the locations and respective annual amounts of groundwater pumping have been identified.

The existing wetlands in southern Utah County have adapted to a wide range of moisture conditions and would be expected to tolerate the increase in soil saturation or surface inundation. The increased spring discharges would be restricted to localized areas immediately adjacent to existing springs. Nonetheless, minor lateral expansion of wetland communities could occur in existing wetland areas or in non-agricultural lands (i.e., lands too wet to be farmed). In addition, an increase in the amount of marsh community could occur, but the extent of this expansion would be limited and unquantifiable.

Increased groundwater discharge or increased surface water return flows could result in increased flows in local streams, which could, in turn, result in changes in the wetland communities along the streams. The primary potentially affected watercourses within the areas eligible to receive water and the areas downgradient in southern Utah County are the lower Spanish Fork River and Beer Creek. Flows in the lower Spanish Fork River would increase from baseline flows throughout the year. The increased flows would have no impact on the bordering riparian shrub and riparian forest communities since inundation of these wetland communities would not increase.

Average monthly flows in Beer Creek would also increase over baseline conditions by about 8 percent (2 cfs during June and July, the months with the lowest average monthly flow). For the remainder of the year, the flows would increase by about 18 percent (an increase of 4 to 14 cfs over baseline). Nonetheless, the stream hydrograph period would be similar to baseline conditions, with peak flows occurring in February and March, followed by sharp decreases during spring and summer. Therefore, there would be no impact to the riparian shrub community bordering Beer Creek.

Potential changes in groundwater and surface water salinity in the lower Spanish Fork River and Beer Creek resulting from increases in return flows or changes in groundwater discharge were also evaluated. The predicted salinity levels with operation of the SFN System would remain similar to, or be slightly reduced from, baseline conditions; therefore, there would no effect of increased salinity on wetland communities within Utah County areas downgradient of the on-farm areas.

Elberta/Goshen Valley. Increased return flows from the Elberta/Goshen Valley area would not result in a measurable change in groundwater levels. Likewise, potential changes in groundwater quality resulting from decreased salinity of flows derived from lower Currant Creek would not be detectable. Therefore, no changes in wetland community acreage or types in Goshen Valley would occur as a result of changes in groundwater quantity or quality.

Eastern Juab County. Increased return flows from on-farm areas in eastern Juab County would result in a substantial, long-term rise in groundwater in the unconfined groundwater recharge areas around the perimeter of Juab Valley. As a result, average annual discharges from springs would increase by 11,900 acre-feet. While the increased discharges would occur primarily in existing discharge areas, there is some potential for discharge to occur in areas where historical springs occur, thereby changing existing wetlands or restoring wetland habitat. The timing of groundwater discharge would be similar to existing seasonal patterns. The localized increase in water levels around discharge areas would be less than 1 foot. The primary effect of the increased spring discharge would be an increase in streamflows in Currant and West Creeks. The headwater areas of these two creeks already have a high degree of soil saturation and have limited ability to store extra water. As described in Section 3.4.5, this area supports a large wetland community (i.e., West Creek/Currant Creek complex) made up of primarily wet meadow and emergent marsh communities.

The major changes predicted to occur as a result of operation of the distribution and on-farm systems in the West Creek/Currant Creek complex would be a conversion of approximately 5 percent (100 acres) of the existing wet meadow community to marsh. This is not considered a significant impact since the conversion would be from a vegetated community type to another vegetated community type. This conversion would be the result of a rise in the high water table and prolonged soil saturation during the irrigation season. Marsh habitat in this wetland complex area is currently limited in extent and generally considered to be of high value to wildlife. Therefore, the increased acreage, which would represent a 50 percent increase in the emergent marsh community type, would be considered a beneficial impact in terms of wildlife value assuming landowners are supportive of the conversion and willing to manage the area in a manner compatible with wildlife use. There would also be some unquantifiable shifts in wet meadow species composition without a community type change within the upper West Creek/Currant Creek complex. Although the increase in wetland acreage within the West Creek/Currant Creek complex is considered to be beneficial impact, an indirect impact could be increased access by aquatic species to formerly isolated wetland areas as a result of surface water connections between wetlands. This increased access

could result in migration or invasion of unwanted exotic species into areas supporting native species. This condition could also occur without the Proposed Action during extremely wet years when the low-lying wetland areas are flooded and connected by surface water. Because of the prevalence of exotic species throughout the region, it is difficult to predict how and when invasion may occur into areas supporting primarily native species.

Another impact of the increased discharge and rise in the high water table in this wetland complex area would be a potential increase in wetlands in areas that have historically supported springs. The most likely area for this to occur is located along the edge of the existing wetland area where the wetland transitions to upland habitat, such as within the vicinity of the Nephi airport. The full extent to which new wetlands, if any, would form in this area is unknown, but it is likely that the increase in wetland acreage could be substantial.

In addition to the changes in the wetland communities in the headwater area of Currant Creek, there is a potential for changes in the existing riparian forest community along upper West Creek. As described in Section 3.4.5.1.6, this riparian shrub community is dominated by tamarisk, which became established from 1983 to 1988 as a result of either increased overbank flooding from West Creek or increased groundwater levels in recharge areas, similar to what would occur as a result of the Proposed Action. The role of either of these two factors or the combination of the two in increased tamarisk invasion is not well understood, and the likelihood of operation of the SFN System to contribute to the further expansion of the tamarisk-dominated riparian shrub habitat cannot be accurately predicted. As previously mentioned, an increase in the wetland areas resulting from an expansion of surface water connections could also allow for invasion of exotic species into areas that currently support sensitive native species. The potential for exotic species invasion/migration could occur without the SFN System under high water or flooded conditions within the West Creek/Currant Creek complex area.

Changes in groundwater salinity in eastern Juab County are not expected to increase wetland soil salinities beyond the range of soil salinities that exist under baseline conditions. Therefore, operation of the SFN System would have no significant impact on soil salinity in wetland communities, nor would it change the type or extent of wetland habitat present.

3.4.6.3.4 Mitigation. The objective of wetland resources mitigation is to mitigate for all permanent loss of wetlands resulting from fill, inundation, or conversion of vegetated wetland type to a non-vegetated wetland type (e.g., conversion of emergent marsh to open water). The plan's overall goal is to mitigate for wetland losses in-kind and as near to the impact areas as feasible (i.e., in place). All mitigation would be implemented within the SFN System impact area of influence. In selecting the mitigation site, the following factors were taken into consideration:

- Opportunities to avoid additional impacts
- Anticipated regulatory requirements
- Specific habitats lost
- Existing condition of potential mitigation site
- Likelihood for successful mitigation
- Rate at which target wetland community would become established
- Type and intensity of management required to establish and maintain created or improved habitat
- Proximity of mitigation area to existing habitat management areas
- Unrelated foreseeable actions that could reduce or increase likelihood for successful habitat creation
- Existing ownership
- Opportunities to create multiuse amenities (wildlife value and recreational use)

The largest wetland loss would occur to the riparian shrub community type. The wetland areas primarily affected are lower Currant Creek, Salt Creek, and numerous existing water distribution canals located within southern Utah and eastern Juab Counties.

3.4.6.3.4.1 ***Proposed Mitigation Site.*** The wetland mitigation area proposed is the Burraston Ponds-Mona springs complex in eastern Juab County. Mitigation at this site could fulfill the mitigation requirements. Based on discussions with the regulatory agencies (FWS, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency [EPA], and the Utah Division of Wildlife), the mitigation ratio for jurisdictional wetlands would likely be a minimum of 2-to-1 for jurisdictional wetlands and 1-to-1 for non-jurisdictional wetlands. However, the final determination of which mitigation ratio would be required would be based on the defined habitat value provided by the lost wetlands and the relative habitat value that could be achieved in the mitigation areas. The following discussion of the proposed mitigation area does not attempt to detail the specific mitigation requirements that would ultimately be required, but instead identifies and discusses the conceptual wetland mitigation plan.

The proposed mitigation site is located northwest of Burraston Ponds. The site is a 102-acre parcel located west of Currant Creek and hydrologically connected to the creek by a 12-inch outfall. The privately owned site is located on a topographic rise above the creek. The site is proposed as mitigation primarily because of the presence of three special-status species (the spotted frog [*Rana letreventris*, formerly *Rana pretiosa*], the least chub [*Iotichthys phlegethontis*], and the California floater [*Anodonta californiensis*]). In addition, a small portion of the site (200 linear feet) also includes Currant Creek. The site is also located next to the Burraston Ponds recreation area and other connected lands managed by the Utah Division of Wildlife.

Mitigation for the loss of wetlands resulting from the Proposed Action at this area would entail purchasing the parcel, assuming there is a willing seller, and acquisition of the water rights to protect the wetland. However, given the total wetland impacts, the purchase of this amount of land would exceed the amount required to meet the 2-to-1 or 3-to-1 mitigation ratio. Management of the site would be turned over to the Utah Division of Wildlife as part of its current management at Burraston Ponds. The site would be primarily for preservation (or conservation) of the sensitive species found in the wetland complex. Other uses, such as recreation or grazing, would be evaluated for their compatibility with the primary management goal, and the site would be managed or held in perpetuity as a wetland mitigation site. The amount of wetland habitat present on the site is estimated to be approximately 70 to 80 acres, primarily consisting of open water, marsh, and wet meadow. In addition to acquisition of the site, there are opportunities to improve the riparian corridor along the 200-foot reach of Currant Creek on the site by terracing the steep-cut banks and planting riparian species such as willow. As the riparian vegetation matures, it would provide shade and cover for aquatic species. Grazing on the property would need to be excluded by fencing or removal of domestic animals.

The open water areas scattered throughout the site are surrounded by emergent marsh vegetation. Some mature trees are present, but no large stands of riparian vegetation are present. The site, however, contains additional areas at the margins of the open water and marsh areas where riparian shrubs could be established.

The advantage of the Burraston Ponds-Mona springs complex as a mitigation site is the feasibility of habitat establishment and maintenance since the source of water to the site is derived from spring discharges (assuming the site acquisition includes the water rights). Under the Proposed Action, spring discharges in this portion of Juab Valley are expected to increase, thereby providing additional water to the site. Maintenance of this mitigation site would include a survey of the properties and the initial and annual inspection and repair of any signs and fencing (to primarily exclude cattle). These maintenance activities would help ensure that the area could be managed for the protection of wetland habitats for special-status species. Vehicle access to the area would likely be restricted to authorized vehicles only.

The primary disadvantage of using this site as a wetland mitigation site is that only a small amount of riparian vegetation would be established. Therefore, in a strict sense, this site does not satisfy the regulatory requirement for no net loss of wetland habitat. The wetland communities that would be purchased are similar to the wetlands lost, but at this time, it is not known if they provide equivalent wetland functions and values. The riparian habitat that could be created along upper Currant Creek would be similar in some respects to the habitat lost along lower Currant Creek; however, the amount of riparian vegetation that could be established at this site is limited.

3.4.6.3.5 Unavoidable Adverse Impacts. Construction of the Proposed Action would not result in any unavoidable adverse impacts since all wetland impacts could be fully mitigated.

3.4.6.4 MCAPW-DFT Alternative

3.4.6.4.1 "Diamond Fork Tunnel Alternative"

3.4.6.4.1.1 Construction Impacts. Under the MCAPW-DFT Alternative, construction impacts associated with the "Diamond Fork Tunnel Alternative" would be the same as described for the Proposed Action.

3.4.6.4.1.2 Operation Impacts

Diamond Fork Creek Above Three Forks (Reach 1). Under the MCAPW-DFT Alternative, flows in upper Diamond Fork Creek (Reach 1) would not change from baseline conditions. Therefore, no operational impacts would occur from the MCAPW-DFT Alternative.

Diamond Fork Creek Below Three Forks (Reaches 2 and 3). Under the MCAPW-DFT Alternative flows below Three Forks would be the same as described under the Proposed Action. Therefore, the operational impacts for the MCAPW-DFT Alternative would be the same as those described for the Proposed Action.

Upper Sixth Water Creek (Above Syar Tunnel). The operational flows within upper Sixth Water Creek would be the same as those described for the Proposed Action; therefore, the impacts would be the same as those described for the Proposed Action.

Lower Sixth Water Creek (Below Syar Tunnel). The operational flows within lower Sixth Water Creek would be the same as those described for the Proposed Action; therefore, the impacts would the same as those described for the Proposed Action.

3.4.6.4.2 Main Conveyance Aqueduct

3.4.6.4.2.1 Construction Impacts. Under the MCAPW-DFT Alternative, construction of the Main Conveyance Aqueduct would be similar to that of the Proposed Action except that no recreation trail would be built and there would be some differences in the alignments of the Salem Bench and Payson Pipelines and the pipeline capacities and diameters of the Spanish Fork and Snell Canyon Pipelines. The right-of-way would the same as that described for the Proposed Action; however, there would be a decrease of 0.1 mile in the total length of the Main Conveyance Aqueduct compared to the Proposed Action (i.e., 45.5 miles compared to 45.6 miles). The change in the total pipeline length and elimination of the recreation trail under this alternative would not change the amount of wetland habitat disturbed over that previously described under the Proposed Action. The total wetland impact resulting from construction of the MCAPW-DFT Alternative is shown in Table 3.4-3.

3.4.6.4.2.2 Operation Impacts

Upper Spanish Fork River. The mean, dry-year, and wet-year flows in the upper Spanish Fork River would increase over baseline conditions throughout the year as a result of the operation of the MCAPW-DFT Alternative. As a result, there would likely be a shift in the wetland communities present. It is predicted that 1.5 acres of the spikerush mudflat community located on the lower terrace areas and 1.7 acres of the wet meadows would convert to creek bed/riverine as a result of higher surface water elevations (see Table 3.4-6). This would be considered a significant impact. No permanent adverse impact to the existing wet meadow or riparian shrub communities is anticipated because of their locations higher in elevation.

Table 3.4-6 Wetland Community Changes Predicted to Result from Operation of the MCAPW-DFT Alternative*			
Location	**Community Type**	**Predicted Community Type Change**	**Acres Converted**
Significant Wetland Community Changes (Conversion to Non-Vegetated or Upland Community Type)			
Main Conveyance Aqueduct			
Upper Spanish Fork River	Spikerush mudflat	Conversion to creek bed/riverine	1.5
	Wet meadow	Gravel bar wet meadow converted to creek bed/riverine	1.7
Lower Currant Creek	Riparian shrub	Creek bed/riverine	0.9
Total Acres of Significant Wetland Community Change			**4.1**
*No adverse wetland impact would result from operation of the "Diamond Fork Tunnel Alternative."			

Lower Currant Creek. Operational impacts on lower Currant Creek would be the same as described for the Proposed Action.

Mona Reservoir. Operational impacts on lower Currant Creek would be the same as described for the Proposed Action.

3.4.6.4.3 Related Actions (Local Development). Under the MCAPW-DFT Alternative, the impacts associated with construction and operation of the Salt Creek Facilities, the Currant Creek Pipeline, and M&I distribution systems would be the same as described under the Proposed Action. Impacts resulting from the Nephi distribution pipelines (north and south), the EJWEP, West Mona distribution pipeline, and SU7 would also be the same as described for the Proposed Action.

Under the MCAPW-DFT Alternative, however, the Mapleton, Salem, South Field, and Lateral 20 distribution pipelines would not be constructed. Instead, a number of short distribution pipelines from Turnout SU1 to SU7 would be constructed in southern Utah County to convey Bonneville Unit water from the Main Conveyance Aqueduct to the High Line Canal. These pipelines would each be less than 0.2 mile in length and would not replace any existing canals. As a result, the impacts associated with the MCAPW-DFT Alternative would be less than described for the Proposed Action. Impacts that would be associated with the MCAPW-DFT Alternative and related actions are summarized in Table 3.4-7.

3.4.6.4.4 Operation Impacts. Operation impacts associated with the MCAPW-DFT Alternative would be the same as described for the Proposed Action.

3.4.6.4.5 Mitigation. The mitigation objective and proposed mitigation site for the MCAPW-DFT Alternative are the same as that described for the Proposed Action except for the difference in the total acres of wetland habitat for which mitigation would need to occur.

3.4.6.4.6 Unavoidable Adverse Impacts. Construction of the MCAPW-DFT Alternative would not result in any unavoidable adverse impacts since all wetland impacts could be fully mitigated.

Table 3.4-7
Wetland Type and Acreage Permanently Removed by Construction and Operation of Related Actions Under the MCAPW-DFT and MCAPW Alternatives

Community Type	Location	Total Wetland Acres Lost[a]
Riparian shrub	Currant Creek Pipeline	0.06
	Salt Creek facilities	0.64
	Salt Creek (Operation)	2.50
Creek bed/riverine	Salt Creek facilities	0.02
Riparian shrub/wet meadow[b]	Nephi/eastern Juab County primary ditches[c]	1.20[d]
Subtotal		**4.4**
Riparian shrub/wet meadow[b]	M&I Distribution System	6.4
Total		**10.7**

[a]Acreage based on widths of 5 and 10 feet.
[b]This classification represents a combination of two intermixed community types. A breakdown of acreage between the two community types was not possible.
[c]Includes North and South Nephi Distribution Systems and the EJWEP distribution system.
[d]Includes the loss of 0.9 acre of riparian shrub that will result when the EJWEP is constructed prior to the Main Conveyance Aqueduct.

3.4.6.5 MCAP Alternative

3.4.6.5.1 Monks Hollow Dam

3.4.6.5.1.1 Construction Impacts. Construction of Monks Hollow Dam would result in the temporary disturbance of 14 acres of riparian wetland and the permanent loss of 0.5 acre of riparian wetland at the dam site. The wetland impacts that would result from construction of Monks Hollow Dam are summarized in Table 3.4-8.

3.4.6.5.1.2 Operation Impacts

Diamond Fork Creek Above Three Forks (Reach 1). Under the MCAP Alternative, no operational changes in flows in Diamond Fork Creek above Three Forks would occur; therefore, no impacts to wetland communities would occur.

Diamond Fork Creek Below Three Forks (Reaches 2 and 3). Operation of Monks Hollow Dam would require the inundation of 45 acres of riparian and creek bed/riverine wetland habitat between Monks Hollow and Three Forks. Below the dam site, operation of the MCAP Alternative would result in an increase in the mean flows over baseline from September through April and a decrease in the irrigation release flows from May through August. The flow regime would be the same as described under the Proposed Action; therefore, the impacts would also be the same as discussed under the Proposed Action.

Upper Sixth Water Creek (Above Syar Tunnel). The changes in flows over baseline would be the same as described under the Proposed Action; therefore, the impacts to wetlands would also be the same as discussed under the Proposed Action.

Table 3.4-8
Wetland Type and Acreage Loss That Would Result from Construction of the MCAP Alternative

Community Type	Location	Approximate Distance Marker (ft)	Temporary Disturbance[a] (acres)	Permanent Disturbance[b] (acres)
Monks Hollow Dam				
Riparian Shrub	Diamond Fork Creek; Monks Hollow Dam	NA	14.0	0.50
Subtotal			**14.0**	**0.5**
Main Conveyance Aqueduct				
Riparian Shrub	Spanish Fork Canyon (seep)	1,680; 2,000	0.01	0.00
	Peteetneet Creek	77,500	1.14	0.00
	North Creek	145,200	0.93	0.00
Creek Bed/Riverine	Spanish Fork River	26,800	0.23	0.00
Saline Meadow	Spanish Fork Canyon	7,100	0.00	0.00
Marsh	Spanish Fork Canyon	15,300	0.01	0.00
Aquatic Bed/Open Water	High Line Canal	45,000-80,000	0.00	0.24
	West Mona facilities	NA	0.00	1.00
Wet Meadow	2 miles north of Mona	-	0.22	0.00
Subtotal			**2.54**	**1.24**
Total			**16.5[c]**	**1.7[c]**

[a]Temporary disturbance means that the wetland area would be restored to its pre-disturbance condition within 5 years.
[b]Permanent disturbance represents wetlands lost through fill or facility siting.
[c]Rounded to nearest tenth.

Lower Sixth Water Creek (Below Syar Tunnel). Under the MCAP Alternative, flows in lower Sixth Water Creek would increase over baseline conditions year-round in the mean, wet, and dry years. As a result, flows would be similar to those that occur under baseline conditions, with large irrigation releases occurring from May through September. As a result, it is expected that there would be no additional loss of riparian habitat, nor would there be any opportunity for any riparian vegetation establishment since high prolonged flows would preclude successful re-establishment over baseline conditions.

3.4.6.5.2 Main Conveyance Aqueduct

3.4.6.5.2.1 Construction Impacts. Under the MCAP Alternative, construction of the Main Conveyance Aqueduct would be the same as described for the Proposed Action. The impacts that would result from construction of the Main Conveyance Aqueduct are summarized in Table 3.4-8.

3.4.6.5.2.2 Operation Impacts

Upper Spanish Fork River. Under the Proposed Action, flows in upper Spanish Fork River would increase over baseline conditions from October through March, but would be less during the irrigation season from April through

September. The impacts expected to result would be similar to those described under the Proposed Action since the flow would be similar to the Proposed Action. The impacts are summarized in Table 3.4-9.

Table 3.4-9
Wetland Community Changes Predicted to Result from Operation of the MCAP and MCATC Alternatives

Location	Community Type	Predicted Community Type Change	Acres Converted
Significant Wetland Community Changes (Conversion to a Non-Vegetated Community Type)			
Monks Hollow Dam			
Diamond Fork Creek	Riparian shrub	Aquatic bed/open water	45.0
Main Conveyance Aqueduct			
Lower Currant Creek	Riparian shrub creek bed/riverine	Creek bed/riverine	0.9
Total Acres of Significant Wetland Community Change			**45.9**
Non-Significant Wetland Community Changes (Conversion to Another Vegetated Wetland Community Type)			
Main Conveyance Aqueduct			
Upper Spanish Fork River	Spikerush mudflat	Conversion to wet meadow	1.5
	Wet meadow	High terrace wet meadow conversion to riparian shrub	1.1*
Total Acres of Non-Significant Wetland Community Change			**2.6**

*Some unquantifiable downslope migration into new seasonal drawdown zone likely.

Lower Currant Creek. Operational impacts on lower Currant Creek would be the same as those described for the Proposed Action.

Mona Reservoir. Operational impacts on Mona Reservoir would be the same as those described for the Proposed Action.

3.4.6.5.3 Related Actions (Local Development). Impacts resulting from construction and operation of the related actions would be similar to those described under the Proposed Action. However, under the MCAP Alternative, Bonneville Unit M&I water would be obtained for local M&I distribution systems directly from Main Conveyance Aqueduct turnouts or local distribution pipelines and would not utilize groundwater resources. Thus, impacts that would be associated with M&I groundwater pumping under the Proposed Action would be avoided under this alternative.

3.4.6.5.4 Mitigation. The mitigation objective and proposed mitigation site for the MCAP Alternative are the same as those described for the Proposed Action except for the difference in the total acres of wetland habitat that would require mitigation. Mitigation would be "in-kind, in-place" (i.e., similar type within same area) to the extent feasible.

3.4.6.5.5 Unavoidable Adverse Impacts. Construction of the MCAP Alternative would result in unavoidable adverse impacts since not all wetland impacts could be fully mitigated. The loss of riparian shrub and creek bed/riverine along Diamond Fork Canyon to inundation by Monks Hollow Reservoir cannot be fully mitigated.

Therefore, the loss of 45 acres is considered a significant unavoidable adverse impact. In the case of loss of creek bed/riverine and riparian shrub wetland along Diamond Fork Creek as a result of inundation by Monks Hollow Dam, "in-kind, in-place" mitigation would not be possible for the creek bed/riverine wetland. Therefore, the impact would remain significant following mitigation.

3.4.6.6 MCAPW Alternative

3.4.6.6.1 Monks Hollow Dam and Main Conveyance Aqueduct

3.4.6.6.1.1 Construction Impacts. Construction impacts on wetland resources as a result of the MCAPW Alternative are shown in Table 3.4-10. Under this alternative, the Main Conveyance Aqueduct would not carry SVP water or deliver Bonneville Unit water to agricultural lands served by the SVP. The alignment for the MCAPW Alternative would be the same as the Proposed Action except that 1) a turnout would be constructed at the end of the Diamond Fork Pipeline to release water to the Spanish Fork River and 2) the pipeline would not replace the High Line Canal between Spanish Fork and Santaquin, but would be routed along the High Line Canal on a separate alignment. As a result of this realignment, the alignment of the Salem Bench Pipeline and the Payson Pipeline would be different from that described for the Proposed Action.

Table 3.4-10
Wetland Type and Acreage Loss from Construction of the MCAPW Alternative

Community Type	Location	Approximate Distance Marker (ft)	Temporary Disturbance[a] (acres)	Permanent Disturbance[b] (acres)
Monks Hollow Dam				
Riparian shrub	Diamond Fork Creek (Monks Hollow Dam)	–	14.0	0.5
Subtotal			**14.0**	**0.5**
Main Conveyance Aqueduct				
Saline Meadow	Spanish Fork Canyon	7,100	0.00	0.00
Marsh	Spanish Fork Canyon	15,300	0.01	0.00
Creek bed/Riverine	Spanish Fork Canyon	26,800	0.23	0.00
Aquatic Bed/Open Water	West Mona facilities	NA	0.00	1.00
Riparian Shrub	Spanish Fork Canyon	1,680; 2,000	0.01	0.00
	Peteetneet Creek	75,000	1.14	0.00
	North Creek	145,200	0.93	0.00
Wet meadow	2 miles north of Mona	–	0.22	0.00
Subtotal			**2.5**	**1.0**
Total			**16.5[c]**	**1.5[c]**

[a]Temporary disturbance means that the wetland area would be restored to its pre-disturbance conditions with 5 years.
[b]Permanent disturbance represents wetland lost through fill or facility siting.
[c]Rounded to the nearest tenth.

The turnout at the end of the Diamond Fork Pipeline would be constructed within the right-of-way of an existing access road and would not adversely affect an adjacent open water/wet meadow wetland. The construction impacts of the MCAPW Alternative would be the same as the Proposed Action within Spanish Fork Canyon because the pipeline would follow the same alignment. Below Spanish Fork Canyon, the alignment would be the same as described for the Proposed Action, except that the pipeline would not replace the High Line Canal between Spanish Fork and Santaquin, but would be routed along the High Line Canal on a separate alignment. Therefore, the impacts would also be identical to the Proposed Action, except that there would be no impact to wetlands parallel to the High Line Canal since the canal would not be affected by installation of the Main Conveyance Aqueduct.

3.4.6.6.1.2 Operation Impacts. Under the MCAPW Alternative, flows in upper Sixth Water Creek would be the same as those described for the Proposed Action. The mean average flows and the effect on wetlands in lower Sixth Water Creek and lower Diamond Fork Creek would be the same as described under the MCAP Alternative. Flows within the Spanish Fork River would increase because SVP water would be released into the Diamond Fork River at the confluence with the Spanish Fork River. Flows in the upper Spanish Fork River would increase over baseline conditions during all months. From May through August, the increase in flows over baseline would range from 50 cfs to 104 cfs. During the non-irrigation season, the increase in flows over baseline would range from 36 cfs to 52 cfs. This increase in surface water elevation on wetlands would result in a permanent loss of 49.1 acres of wetland as a result of conversion of vegetated wetland to unvegetated wetland (see Table 3.4-11). Operational impacts on lower Currant Creek and Mona Reservoir would be the same as the Proposed Action.

Table 3.4-11
Wetland Community Changes Predicted to Result from Operation of the MCAPW and MCAT Alternatives

Location	Community Type	Predicted Community Type Change	Acres Converted
Significant Wetland Community Changes (Conversion to Non-Vegetated or Upland Community Type)			
Monks Hollow Dam			
Diamond Fork Creek	Riparian shrub/creek bed	Conversion to open water	45.0
Subtotal			**45.0**
Main Conveyance Aqueduct			
Upper Spanish Fork River	Spikerush mudflat	Conversion to creek bed/riverine	1.5
	Wet meadow	Gravel bar wet meadow converted to creek bed/riverine	1.7
Lower Currant Creek	Riparian shrub	Creek bed/riverine	0.9
Subtotal			**4.1**
Total Acres of Significant Wetland Community Change			**49.1**

3.4.6.6.2 Related Actions (Local Development). Impacts to wetlands from construction and operation of the distribution, on-farm, and M&I distribution systems would be similar to those described for the MCAPW-DFT Alternative. However, under the MCAPW Alternative, Bonneville Unit M&I water would be obtained for local M&I distribution systems directly from Main Conveyance Aqueduct turnouts and would not utilize groundwater resources. Thus, impacts that would be associated with M&I groundwater pumping under the MCAPW-DFT Alternative would be avoided under this alternative.

3.4.6.6.3 Mitigation. Mitigation for the MCAPW Alternative would be the same as that discussed for the Proposed Action. The loss of riparian shrub and creek bed/riverine along Diamond Fork Canyon to inundation by Monks Hollow Reservoir cannot be fully mitigated. Therefore, the loss of 45 acres is considered a significant unavoidable adverse impact. In the case of loss of creek bed/riverine and riparian shrub wetland along Diamond Fork Creek as a result of inundation by Monks Hollow Dam, "in-kind, in-place" mitigation would not be possible for the creek bed/riverine wetland. Therefore, the impact would remain significant following mitigation.

3.4.6.6.4 Unavoidable Adverse Impacts. The loss of riparian shrub and creek bed/riverine habitat along Diamond Fork Canyon to inundation by Monks Hollow Reservoir cannot be fully mitigated. Therefore, the loss of 45 acres is considered a significant unavoidable adverse impact.

3.4.6.7 MCATC Alternative

3.4.6.7.1 Monks Hollow Dam Construction and Operation Impacts. The impacts associated with construction and operation of Monks Hollow Dam would be the same as described under the MCAP Alternative.

3.4.6.7.2 Main Conveyance Aqueduct. The following sections describe the construction- and operation-related impacts resulting from the MCATC Alternative Main Conveyance Aqueduct.

3.4.6.7.2.1 Construction Impacts. As a result of the MCATC Alterative, construction of wetland and riparian crossings would occur as described in Chapter 1 and all wetlands would be restored to the pre-disturbance community type. As shown in Table 3.4-12, 2.2 acres would be temporarily disturbed within the Main Conveyance Aqueduct right-of-way. Similar permanent impacts would occur through fill placement in wetland areas as described under the Proposed Action, except that no permanent loss of wetland habitat within the High Line Canal would occur as a result of the construction of the Main Conveyance Aqueduct and associated features. In addition, the pipeline alignment would cross the Spanish Fork River at a different location than under the Proposed Action. Therefore, a total of 1.6 acres of wetland would be permanently lost through placement of fill during construction of the Main Conveyance Aqueduct.

3.4.6.7.2.2 Operation Impacts. As a result of the MCATC Alternative, the same amount of water would be delivered by the SFN System as described under the Proposed Action. However, some turnout locations would vary because of differences in pipeline alignment. Impacts on wetlands from operation of the MCATC Alternative would be the same as those described for the MCAP Alternative.

3.4.6.7.3 Related Actions (Local Development). Impacts to wetland resources from the construction and operation of the distribution, on-farm, and M&I distribution systems under the MCATC Alternative are considered below and summarized in Table 3.4-13.

3.4.6.7.3.1 Construction and Operation. Construction of the MCATC Alternative would be the same as described for the Proposed Action with respect to the Salt Creek facilities, the Currant Creek Pipeline, Nephi Distribution Systems, the EJWEP, West Mona distribution pipeline, and SU7. However, impacts associated with construction of the Mapleton, Salem, and Lateral 20 distribution pipelines would differ from those described for the Proposed Action. In addition, construction of SU2 would require replacing 1.8 miles of existing canal and constructing 2.7 miles of new pipeline; construction of SU3 would require replacing 1.6 miles of existing canal and constructing 2.5 miles of new pipeline. SU4 would replace 1.0 mile of existing canal and 1.7 miles of new pipeline would be constructed. SU6 would require the construction of 0.3 mile of new pipeline.

The Lateral 20 distribution pipeline would replace 8.5 miles of existing canal (Lateral 20) and a total of 10.7 miles of new pipeline would be built. As part of the improvements, 0.7 mile of High Line Canal would be replaced and 1.0 mile of the High Line Canal would be abandoned (east of Payson). A total of 18.0 acres would be lost as shown in Table 3.4-13.

Table 3.4-12
Wetland Type and Acreage Loss Resulting from Construction of the MCATC and MCAT Alternatives

Community Type	Location	Approximate Distance Marker (ft)	Temporary Disturbance[a] (acres)	Permanent Disturbance[b] (acres)
Monks Hollow Dam				
Riparian shrub	Diamond Fork Creek	–	14.0	0.5
Subtotal			**14.0**	**0.5**
Main Conveyance Aqueduct				
Creek bed/riverine	Spanish Fork River	13,300	0.16	0.02
Riparian shrub	Spanish Fork Canyon (seep) Peteetneet Creek North Creek	1,584 60,500 144,800-145,000	1.84	0.64
Aquatic bed/open water	West Mona facilities	NA	0.00	1.00
Wet meadow	2 miles north of Mona	157,250	0.22	0.00
Subtotal			**2.22**	**1.66**
Total			**16.2[c]**	**2.2[c]**

[a]Temporary disturbance means that the wetland area would be restored to its pre-disturbance condition within 5 years.
[b]Permanent disturbance represents wetland loss through fill or facility siting.
[c]Rounded to the nearest tenth.

Construction of M&I distribution systems under the MCATC Alternative would have the same impacts as described for the Proposed Action (i.e., 6.4 acres of riparian shrub/wet meadow conversion to upland habitat). Under the MCATC Alternative, Bonneville Unit M&I water would be obtained for local M&I distribution systems directly from Main Conveyance Aqueduct turnouts or local distribution pipelines and would not utilize groundwater resources. Thus, impacts that would be associated with M&I groundwater pumping under the Proposed Action would be avoided under this alternative.

3.4.6.7.4 Mitigation. Mitigation for the MCATC Alternative would be the same as that discussed for the Proposed Action, except that the total acres of wetland loss required to be mitigated would be different.

3.4.6.7.5 Unavoidable Adverse Impacts. The loss of riparian shrub and creek bed/riverine habitat along Diamond Fork Canyon to inundation by Monks Hollow Reservoir could not be fully mitigated. Therefore, the loss of 45 acres is considered a significant unavoidable adverse impact.

3.4.6.8 MCAT Alternative

3.4.6.8.1 Monks Hollow Dam and Main Conveyance Aqueduct. The following sections describe the construction- and operation-related impacts resulting from the MCAT Alternative.

3.4.6.8.1.1 Construction Impacts. Impacts to wetlands from construction of Monks Hollow Dam and the MCAT Alternative Main Conveyance Aqueduct would be the same as those described for the MCATC Alternative (see Table 3.4-12).

Table 3.4-13 Wetland Type and Acreage Permanently Removed by Construction and Operation of the Related Actions as a Result of the MCATC Alternative		
Community Type	**Location**	**Total Wetland Acres Lost**
Irrigation Distribution System		
Riparian shrub	Mapleton Distribution Canal	1.38
	South Field Canal	1.20
	Salem Canal	0.95
	Lateral 20 (with Payson spur)[a]	3.50
	Currant Creek Pipeline	0.06
	Salt Creek facilities	0.64
	Salt Creek (Operation)	2.50
	SU2, SU3, SU4, SU6, SU7	0.16
Creek bed/riverine	Salt Creek facilities	0.02
Riparian shrub/wet meadow	Nephi/eastern Juab County primary ditches[b]	1.20[c]
Subtotal		**11.6**
Riparian shrub/wet meadow	M&I Distribution System	6.4
Total		**18.0[d]**

[a]Based on estimated 6-foot average width of riparian shrub along 5 percent of the total High Line Canal length to be eliminated.
[b]Includes North and South Nephi Distribution Systems and the EJWEP distribution system.
[c]Includes loss of 0.9 acre of riparian that will be removed as a result of the EJWEP, which will be constructed prior to the Main Conveyance Aqueduct.
[d]Rounded to the nearest tenth.

3.4.6.8.1.2 Operation Impacts. Operation of the MCAT Alternative would result in increased flows in the upper Spanish Fork River primarily during the irrigation season. Flows from October through April would also be increased from baseline conditions. The increase in summer (i.e., irrigation season) flows would not, however, change the magnitude or timing of the 2- and 10-year flood flows. The predicted change in wetland acreage is summarized in Table 3.4-11. The impact on wetland communities as a result of operation of the Main Conveyance Aqueduct would be a conversion of 4.1 acres of wetland habitat.

3.4.6.8.2 Related Actions (Local Development). Impacts to wetlands from construction and operation of the distribution, on-farm, and M&I distribution systems would be the same as those described for the MCATC Alternative except that no changes or improvements to the four primary canals in southern Utah County (i.e., Mapleton, South Field, Salem, and Lateral 20) would occur as a result of the MCAT Alternative. These canals would not be replaced by pipeline and would continue to operate as at present. Therefore, wetland impacts associated with the MCAT Alternative distribution systems from construction and operation of eastern Juab County primary ditches and the M&I distribution system would result in wetland losses of 10.8 acres as shown in Table 3.4-14.

3.4.6.8.3 Mitigation. Mitigation for the MCAT Alternative would be same as that discussed for the Proposed Action, except that the total acres of wetland loss requiring mitigation would be different.

Table 3.4-14
Wetland Type and Acreage Permanently Removed by Construction and Operation of the Related Actions as a Result of the MCAT Alternative

Community Type	Location	Total Wetland Acres Lost
Irrigation Distribution System		
Riparian shrub	Currant Creek Pipeline	0.06
	Salt Creek facilities	0.64
	Salt Creek (Operation)	2.50
Creek bed/riverine	Salt Creek facilities	0.02
Riparian shrub/wet meadow	Nephi/eastern Juab County primary ditches[a]	1.20[b]
Subtotal		**4.4**
Riparian shrub/wet meadow	M&I Distribution System	6.4
Total		**10.8[c]**

[a]Includes North and South Nephi Distribution Systems and EJWEP distribution system.
[b]Includes loss of 0.9 acre of riparian that will be removed as a result of the EJWEP, which will be constructed prior to the SFN System.
[c]Rounded to nearest tenth.
Note: Existing canals (i.e., Mapleton, South Field, Lateral 20, or Salem Canals) would not be modified as a result of the MCAT Alternative. No modifications to the High Line Canal would be required for construction of Turnouts SU2 through SU7.

3.4.6.8.4 Unavoidable Adverse Impacts. The loss of riparian shrub and creek bed/riverine habitat along Diamond Fork Canyon to inundation by Monks Hollow Reservoir cannot be fully mitigated. Therefore, the loss of 45 acres is considered a significant unavoidable adverse impact.

3.4.6.9 No Action Alternative

The following sections describe the construction and operation impacts associated with the No Action Alternative. Under the No Action Alternative, Three Forks Dam would be constructed, but the Main Conveyance Aqueduct facilities or related actions would not be built.

3.4.6.9.1 Construction Impacts. Construction of the Diamond Fork Pipeline Extension from the existing Diamond Fork Pipeline to Three Forks would require temporarily disturbing approximately 1.0 acre of creek bed/riverine community along Diamond Fork Creek. In addition, it is estimated that roughly 8 acres of riparian shrub (based on an average width of 30 feet of riparian vegetation) would be removed during construction of the pipeline extension. The disturbed areas would be restored following construction. A total of 0.5 acre of creek bed/riverine and riparian would be permanently removed as a result of construction of the dam. These impacts are shown in Table 3.4-15. Because no Main Conveyance Aqueduct or related action facilities would be built under the No Action Alternative, no additional construction impacts on wetlands would occur.

3.4.6.9.2 Operation Impacts

3.4.6.9.2.1 Diamond Fork Creek Above Three Forks (Reach 1). Under the No Action Alternative, no operational changes in flows in Diamond Fork Creek above Three Forks would occur; however, operation of the dam would inundate a total of 23 acres of riparian wetland.

Table 3.4-15
Wetland Community Changes Predicted to Result from Construction and Operation of the No Action Alternative

Location	Community Type	Temporary Disturbance	Permanent Disturbance/ Conversion (acres)
Three Forks Dam Construction			
Sixth Water Creek	Riparian	8.0	NA
	Creek bed/riverine	1.0	NA
	Creek bed/riverine	NA	0.5
Three Forks Dam Operation			
Diamond Fork Creek	Riparian	NA	23.0[a]
Upper Spanish Fork River	Spike mudflat	NA	1.5[b]
	Wet meadows	NA	1.0[c]
Related Actions			
M&I Distribution Systems	Riparian shrub/wet meadow[d]	6.4	6.4
Total Acres of Significant Wetland Community Change			**32.4**

[a]Permanent conversion to aquatic bed/open water
[b]Permanent conversion to creek bed/riverine
[c]Gravel bar wet meadow converted to creek bed/riverine
[d]This classification represents a combination of two intermixed community types that would be permanently converted to upland habitat.

3.4.6.9.2.2 Diamond Fork Creek Below Three Forks (Reaches 2 and 3). Operation of the No Action Alternative would result in an increase in the mean flows over baseline from October through May, but irrigation release flows from June through September would decrease, resulting in a more stable surface water elevation. The effect of this more stable flow regime would be similar to that discussed under the Proposed Action wherein the channel would move toward forming a single meandering channel. No loss of wetlands is expected to occur.

3.4.6.9.2.3 Upper Sixth Water Creek (Above Syar Tunnel). The changes in flows over baseline would be the same as those described for the Proposed Action; therefore, the impacts to wetlands would also be the same as those discussed for the Proposed Action.

3.4.6.9.2.4 Lower Sixth Water Creek (Below Syar Tunnel). Under the No Action Alternative, flows in lower Sixth Water Creek would increase over baseline conditions year-round in mean, wet, and dry years. As a result, flows would be similar to those that occur under baseline conditions, with large irrigation releases occurring from May through September. As a result, it is expected that there would be no additional loss of riparian habitat, nor would there be any opportunity for any riparian vegetation establishment since high prolonged flows would preclude successful establishment.

3.4.6.9.2.5 Upper Spanish Fork River. As a result of the No Action Alternative, flows in the upper Spanish Fork River would increase above baseline throughout the year, and the magnitude of flood flows would increase slightly over baseline conditions. Flows would be greater than baseline flows in every month as a result of release to the upper Spanish Fork River of all water carried in the Diamond Fork Pipeline. The timing of flood events of

10 years and higher would not change. The changes in wetland habitat resulting from the No Action Alternative would be similar to those described for the Proposed Action. As shown in Table 3.4-14, changes in hydrologic regime would result in a total conversion of 2.5 acres of vegetated wetland to a creek bed/riverine community type. Because there would be no change in the operation of Salt Creek, Mona Reservoir, or lower Currant Creek, there would be no impacts to wetlands along these water bodies.

3.4.6.9.2.6 M&I Distribution Systems. Development of local M&I distribution systems would have the same impacts as described under the Proposed Action.

3.4.6.9.3 Mitigation. Mitigation for the No Action Alternative would be same as that discussed for the Proposed Action, except that the total number of acres of wetland loss requiring mitigation would be less.

3.4.6.9.4 Unavoidable Adverse Impacts. The loss of wetlands as a result of construction and operation of the No Action Alternative could be fully mitigated except for the loss of 0.5 acre of creek bed/riverine that would be lost to construction of Three Forks Dam and Reservoir. This impact would remain significant and is considered an unavoidable adverse impact.

3.4.6.10 Summary of Impacts

A summary of impacts for the Proposed Action and each of the alternatives is presented in Table 3.4-16. The impacts include permanent disturbance through fill or inundation, as well as temporary disturbance during construction and operation activities.

Table 3.4-16
Summary of Impacts for Wetland Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
"Diamond Fork Tunnel Alternative" Construction				
Riparian Shrub	0.2 acre temporary	Not significant	None required. Revegetation procedures would be implemented.	Not significant
Creek bed/riverine	0.4 acre temporary	Not significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Main Conveyance Aqueduct Construction				
Marsh; creek bed/ riverine; wet meadow; riparian shrub	2.54 acres temporary	Not significant	None required. SOPs and revegetation procedures would be implemented	Not significant
Aquatic bed/open water	1.2 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant

Table 3.4-16
Summary of Impacts for Wetland Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Main Conveyance Aqueduct Operation				
Riparian shrub	0.9 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Spikerush mudflat; wet meadow	2.6 acres converted to another wetland type	Not significant	None required. SOPs and revegetation would be implemented	Not significant
Related Actions Construction and Operation				
Irrigation Distribution Systems				
Riparian shrub/wet meadow; creek bed/ riverine	15.3 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
M&I Distribution System				
Riparian shrub/wet meadow	6.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
MCAPW-DFT Alternative				
"Diamond Fork Tunnel Alternative" Construction - Same as Proposed Action				
Main Conveyance Aqueduct Construction - Same as Proposed Action				
Main Conveyance Aqueduct Operation				
Riparian shrub	0.9 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Spikerush mudflat; wet meadow	3.2 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Related Actions Construction and Operation				
Irrigation Distribution Systems				
Riparian shrub	4.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Creek bed/riverine	0.02 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
M&I Distribution System				
Riparian shrub/wet meadow	6.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant

Table 3.4-16
Summary of Impacts for Wetland Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
MCAP Alternative				
Monks Hollow Dam Construction				
Riparian shrub	14.0 acres temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
	0.5 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Monks Hollow Dam Operation				
Riparian shrub	45.0 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Significant
Main Conveyance Aqueduct Construction				
Aquatic bed/open water	1.24 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Riparian shrub; creek bed/riverine; marsh; wet meadow	2.54 acres temporary	Not significant	None required. SOPs and revegetation procedures would be implemented	Not significant
Main Conveyance Aqueduct Operation				
Riparian shrub	0.9 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Spikerush mudflat; wet meadow	2.6 acres permanent	Not significant	None	Not significant
Related Actions Construction and Operation - Same as Proposed Action				
MCAPW Alternative				
Monks Hollow Dam Construction - Same as MCAP Alternative				
Monks Hollow Dam Operation - Same as MCAP Alternative				
Main Conveyance Aqueduct Construction				
Marsh; creek bed/ riverine; wet meadow	0.46 acre temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Riparian shrub	2.08 acres temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Aquatic bed/open water	1.0 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant

Table 3.4-16
Summary of Impacts for Wetland Resources
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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Main Conveyance Aqueduct Operation				
Riparian shrub	0.9 acre permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Spikerush mudflat; wet meadow	3.2 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Related Actions Construction and Operation - Same as MCAPW-DFT Alternative				
MCATC Alternative				
Monks Hollow Dam Construction - Same as MCAP Alternative				
Monks Hollow Dam Operation - Same as MCAP Alternative				
Main Conveyance Aqueduct Construction				
Creek bed/riverine; wet meadow; riparian shrub	2.2 acres temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Creek bed/riverine; riparian shrub; aquatic bed/open water	1.66 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Main Conveyance Aqueduct Operation - Same as MCAP Alternative				
Related Actions Construction and Operation				
Irrigation Distribution Systems				
Riparian shrub; creek bed/riverine	11.6 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
M&I Distribution System				
Riparian shrub/wet meadow	6.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
MCAT Alternative				
Monks Hollow Dam Construction - Same as MCATC Alternative				
Monks Hollow Dam Operation - Same as MCAP Alternative				
Main Conveyance Aqueduct Construction - Same as MCATC Alternative				
Main Conveyance Aqueduct Operation - Same as MCAP Alternative				

Table 3.4-16
Summary of Impacts for Wetland Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Related Actions Construction and Operation				
Irrigation Distribution Systems				
Riparian shrub; creek bed/riverine	4.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
M&I Distribution System				
Riparian shrub/wet meadow	6.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
No Action Alternative				
Three Forks Dam Construction				
Riparian shrub	8.0 acres temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Creek bed/riverine	1.0 acre temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
Creek bed/riverine	0.5 acre permanent	Significant	None	Significant
Three Forks Dam Operation				
Riparian shrub	23.0 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant
Spikerush mudflat; wet meadows	2.5 acres temporary	Significant	None required. SOPs and revegetation procedures would be implemented.	Not significant
M&I Distribution Systems				
Riparian shrub/wet meadow	6.4 acres permanent	Significant	Wetland mitigation would be implemented to achieve "no net loss" of wetlands.	Not significant

3.4.7 Cumulative Impacts

Chapter 1, Section 1.8 identifies the projects included in the cumulative analysis. The following is an analysis of each project with respect to the potential cumulative impacts that may occur with implementation of the Proposed Action and alternatives.

Recreation Trail. The recreation trail plans described in Section 1.8 would not likely have any cumulative impacts on wetland resources when combined with the Proposed Action and alternatives.

Nephi Airport. Expansion of the Nephi Airport is proposed within existing agricultural lands near the existing airport property. If the airport expansion is limited to only agricultural lands, then it is not anticipated that any additional wetlands would be affected by expansion of the airport. Therefore, no cumulative impacts on wetlands would occur.

Utah Lake Preserve. Implementation of the Utah Lake Preserve as proposed, combined with the Proposed Action and alternatives, would not result in any cumulative adverse impacts. The Utah Lake Preserve project proposes to ultimately acquire and manage approximately 22,000 acres of land (some of which are currently wetlands, as well as lands that have been converted from wetland to agricultural lands). As a result, there could be a net increase in the amount of wetland habitat within the region, assuming no other wetland loss within the area as a result of other projects.

Western Transportation Corridor Expansion (Legacy Project). The Legacy Project would be constructed from Nephi to Ogden, passing west of Mona Reservoir and Utah Lake. Although details for the alignment are not available at this time, it is likely that the roadway would cross wetland habitat within Juab Valley and near Utah Lake. As a result, some wetland habitat may be permanently lost as a result of grading and filling for the roadway. That project, combined with the Proposed Action and alternatives, would result in a cumulative adverse impacts on wetlands.

Diamond Fork Creek and Sixth Water Creek Restoration Plan. The Restoration Plan would be designed to enhance cottonwood growth and riparian habitat establishment and to re-establish the stream corridor of both creeks. Since the Proposed Action and alternatives would result in more stable creek flows, there would be a beneficial cumulative effect.

Central Valley Water Reuse Project. The Central Valley Water Reuse Project would provide for conservation, treatment, and reuse of wastewater effluent for irrigation uses within Salt Lake County. A cumulative beneficial impact to wetlands as a result of this project and the SFN System is that there could be a decrease in the demand for and reliance on groundwater for agricultural uses. It is not possible at this time to determine if there could be any adverse cumulative impacts on wetland values as a result of decreased water quality resulting from the combination of the projects.

3.5 Wildlife Resources

3.5.1 Introduction

This section addresses potential impacts to wildlife species and their habitat that would result from the construction, operation, and maintenance of the SFN System and related distribution and on-farm systems. The information and analysis provided in this section were summarized from the *Wildlife Resources Technical Report* (CUWCD 1998e). Information on wetland habitat conditions was taken from Section 3.4, Wetland Resources, and was used to address impacts to wetland-related wildlife. Potential impacts to special-status wildlife species are discussed in Section 3.7.

3.5.2 Issues Eliminated from Further Analysis

No issues have been eliminated from further analysis.

3.5.3 Issues Addressed in the Impact Analysis

The issues and concerns identified below are addressed in the following impact analysis:

- Modification of wildlife habitat on agricultural lands that would result from changes in irrigation systems, including replacement of open ditches with pipelines and sprinklers, and from changes in irrigation and cropping patterns
- Impacts to big game populations resulting from construction and operation of SFN System facilities within designated critical winter range
- Impacts to wildlife habitats resulting from construction and operation of SFN System facilities
- Elimination of drowning hazards for big game created by the open High Line and Salem Canals
- Influence of SFN System facilities on crop depredation by big game
- Operation-induced effects on wetland habitats used by wildlife

3.5.4 Description of Impact Area of Influence

The impact area of influence for wildlife resources consists of both terrestrial and aquatic habitats in southern Utah and eastern Juab Counties that could be directly or indirectly affected by the construction, operation, and maintenance of the SFN System and related actions. The impact area of influence includes the Diamond Fork drainage and the Spanish Fork River to the northeast, Hobble Creek to the north, Currant Creek and West Creek to the west, the Wasatch Mountains to the east, and the San Pitch Mountains to the south.

3.5.5 Affected Environment

This section describes representative wildlife species and habitats that could be affected by activities associated with construction and operation of the SFN System and proposed related actions. The types of wildlife resources located within the impact area of influence that could be affected are similar for the Proposed Action and each of the alternatives. The impact area of influence for wildlife varies by species, depending on their individual habitat requirements, distribution, mobility, and sensitivity to disturbance. For example, the impact area of influence may extend substantially beyond the Main Conveyance Aqueduct right-of-way and facility sites for

species with a low tolerance for disturbance (e.g., some nesting raptors), while the reverse is true for species that possess limited mobility, small home ranges, or high tolerance of disturbance.

3.5.5.1 Wildlife Habitat

Nine major plant communities that provide wildlife habitat were delineated within the impact area of influence. These communities are oak woodland, sagebrush/grass, bitterbrush/grass, pinyon/juniper, wetlands, agricultural lands, previously disturbed areas, mountain brush, and aspen/conifer.

3.5.5.1.1 Oak Woodland. The oak woodland, or shrub oak community, is a major component of foothill vegetation along the Wasatch Mountains within the impact area of influence. This community generally occurs between 5,500 and 6,500 feet in elevation from the Spanish Fork Canyon south to the Utah-Juab county line. Scrub oaks (*Quercus gambelii*) are shrubs or small deciduous trees that often exist in "clumps" separated by open spaces dominated by big sagebrush (*Artemisia tridentata*) or a variety of native grass species.

3.5.5.1.2 Sagebrush/Grass. The sagebrush/grass community covers a substantial portion of the mountains, foothills, and valleys along the Wasatch Front and is common in the Diamond Fork drainage, along much of the proposed Main Conveyance Aqueduct alignment, and near Mona Reservoir. The dominant shrub species within this community is big sagebrush. Other important shrub species are rubber rabbitbrush (*Chrysothamnus nauseosus*), low rabbitbrush (*Chrysothamnus viscidiflorus*), and broom snakeweed (*Gutierrezia sarothrae*). Dominance of grasses varies between sites, but the most common species are bluebunch wheatgrass (*Elymus spicatus*), western wheatgrass (*Elymus smithii*), cheatgrass, and muttongrass (*Poa fendleriana*). Dominant forbs are yarrow (*Achillea millefolium*), lupines (*Lupinus* spp.), and asters (*Aster* spp.).

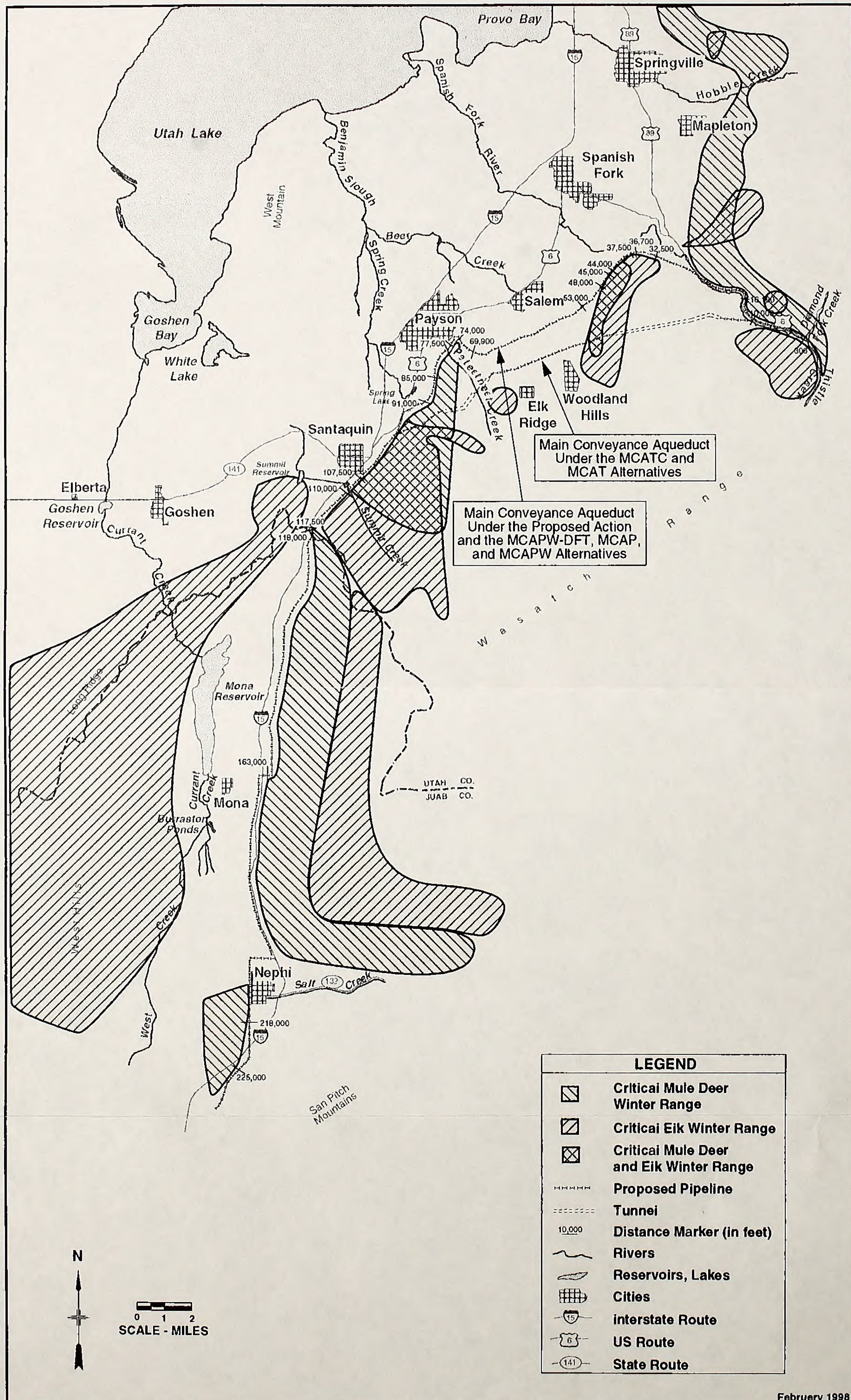
3.5.5.1.3 Bitterbrush/Grass. Small, scattered areas of bitterbrush/grass occur in the vicinity of Rocky Ridge south of Payson. The bitterbrush/grass community in this area is dominated by bitterbrush and bluebunch wheatgrass. The overall species composition is similar to the sagebrush/grass community described above.

3.5.5.1.4 Pinyon/Juniper. The pinyon/juniper community within the impact area of influence is restricted to ridges in the Diamond Fork drainage and a small portion along the proposed Main Conveyance Aqueduct alignment near the Utah-Juab county line. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) dominate this community.

3.5.5.1.5 Wetlands. As described in Section 3.4, Wetland Resources, 11 wetland community types are present throughout the impact area of influence. The primary communities present (based on acreage distribution) are wet meadow, marsh, saline meadow, riparian shrub, and riparian forest. Six other wetland community types are also present but less abundant; these are wet meadow/marsh, saline wet meadow/marsh, saline playa, creek bed/riverine, aquatic bed/open water, and spikerush mudflat. These wetlands are distributed in a mosaic fashion throughout the impact area of influence (see Map 3.4-1).

3.5.5.1.6 Agricultural Lands. Much of the native vegetation within the impact area of influence has been converted to dryland and irrigated agriculture, consisting primarily of cultivated crops, small grains, orchards, alfalfa, and pasture. Baseline agricultural cropping patterns and irrigation methods are discussed in Section 3.9.5.1.

Agricultural lands provide habitat for wildlife within the impact area of influence. As discussed in Section 3.9, Agriculture, of the 79,950 acres of agricultural land eligible to receive Bonneville Unit water (see Map 1-11), an estimated 53,930 acres would actually receive Bonneville Unit water. Since the specific location of these lands cannot be identified until water service contracts are finalized, the same subsampling approach used to determine baseline cropping conditions and to assess impacts on agriculture was used for wildlife. This approach resulted in the identification of several areas that were representative of the predominant agricultural patterns and associated wildlife values throughout the impact area of influence.



Map 3.5-2
Critical Big Game Habitat Within the Main Conveyance Aqueduct Area of Influence

Existing cultivated lands have relatively low wildlife values, low species and structural diversity, and high levels of human disturbance associated with agricultural production such as regular discing, mowing, burning, harvesting, flooding, and pesticide application. These conditions have reduced wildlife species diversity and caused a shift in relative abundance because many native species have been replaced by exotics such as the bullfrog (*Rana catesbeiana*), ring-necked pheasant (*Phasianus colchicus*), rock dove (*Columba livia*), and European starling (*Sturnus vulgaris*). Species that exist in large numbers on cultivated lands are those that are relatively tolerant of human activity and adaptable to dynamic land-use practices. For example, a variety of grain-eating bird species such as Canada goose (*Branta canadensis*), Brewer's blackbird (*Euphagus cyanocephalus*), and common raven (*Corvus corax*) feed extensively on waste grain when available.

3.5.5.1.7 Previously Disturbed Lands. A small amount of previously disturbed lands occurs in the impact area of influence. Previously disturbed lands are non-native habitats, other than cultivation, and are typically located adjacent to highways, railroads, and other rights-of-way. Most of these areas have been reseeded to a grass/forb community for erosion control, to provide food and cover for wildlife, or for aesthetic purposes. Dominant species within these reseeded areas include yellow sweet clover (*Melilotus officinalis*), pepperweed (*Lepidium montanum*), curly gumweed (*Grindelia squarrosa*), sunflower (*Helianthus annuus*), and bluegrass (*Poa pratensis*).

3.5.5.1.8 Mountain Brush. Mountain brush habitat is the most prevalent vegetation type in the Diamond Fork drainage and occurs at almost all elevations. It is primarily a shrub community dominated by oakbrush and snowberry (*Symphoricarpos longiflorus*). Other important species include big sagebrush, alder-leaf mountain mahogany (*Cercocarpus montanus*), and rabbitbrush (*Chrysothamnus* sp.).

3.5.5.1.9 Aspen/Conifer. This habitat type has limited distribution in the Diamond Fork drainage. It occurs primarily at higher elevations around 8,000 feet. It is dominated by single and mixed stands of quaking aspen (*Populus tremuloides*) and fir (*Abies* spp.).

3.5.5.2 General Wildlife

The nine plant communities identified above provide habitat for a diverse mix of wildlife species. Representative species from the major wildlife groups and their primary habitat associations are discussed below.

3.5.5.2.1 Amphibians. Amphibians located within the impact area of influence are generally associated with wetland habitats such as marshes, springs, streams, ponds, and wet meadow/pasture habitats. Permanent wetlands generally receive higher use by amphibians than temporary wetlands. Characteristic species include Utah tiger salamander (*Ambystoma tigrinum utahensis*), western (northern) chorus frog (*Pseudacris triseriata*), leopard frog (*Rana pipiens*), bullfrog, and Woodhouse's toad (*Bufo woodhousei*).

3.5.5.2.2 Reptiles. Foothill shrub and grassland habitats within the impact area of influence provide good habitat for reptiles. Lizards common to these habitats include northern sagebrush lizard (*Sceloporus graciosus*), northern side-blotched lizard (*Uta stansburiana*), Great Basin (western) whiptail (*Cnemidophorus tigris*), and Salt Lake horned lizard (*Phrynosoma douglassi ornatum*). Snakes occur most commonly near water in canyons and near valley wetlands. Species likely to occur within the impact area of influence include wandering garter snake (*Thamnophis elegans vagrans*), Great Basin gopher snake (*Pituophis melanoleucus deserticola*), and western yellow-bellied racer (*Coluber constrictor mormon*).

3.5.5.2.3 Waterbirds. Waterfowl, shorebirds, wading birds, gulls, and terns are seasonally common in wetland habitats throughout the impact area of influence, especially around Mona Reservoir and Burraston Ponds, and in scattered marshes and flooded pastures. Irrigation canals and ditches provide some additional habitat of limited value to waterbirds. Characteristic species include double-crested cormorant (*Phalacrocorax auritus*), Canada

goose, mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), great blue heron (*Ardea herodias*), sandhill crane (*Grus canadensis*), common snipe (*Gallinago gallinago*), and California gull (*Larus californicus*).

3.5.5.2.4 Raptors. Wetlands, agricultural lands, grasslands, and deciduous woodlands surrounding Mona Reservoir and Burraston Ponds and within the Diamond Fork drainage provide important habitat for raptors. Several raptors are known to nest in the impact area of influence including northern harrier (*Circus cyaneus*) and great horned owl (*Bubo virginianus*). Other raptors known to be present within the impact area of influence include turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), osprey (*Pandion haliaetus*), and American kestrel (*Falco sparverius*).

3.5.5.2.5 Upland Game Birds. Ring-necked pheasants use agricultural lands and perennial grasslands as their primary habitat within the impact area of influence. However, nesting occurs most frequently in alfalfa and sagebrush (Smith and Greenwood 1983a). Habitats frequented by pheasants during winter include railroad rights-of-way; sagebrush or rabbitbrush; densely vegetated agricultural fields and fence rows; haystacks; willows and other deciduous trees; and cattail marsh in the vicinity of Mona Reservoir and Burraston Ponds. Mourning doves (*Zenaida macroura*) occur most frequently during summer on agricultural lands and, to a lesser extent, in pasture and sagebrush. A rapid decline in mourning dove numbers occurs each fall with the onset of colder temperatures and increased precipitation. Chukar (*Alectoris chukar*) are known to occupy sagebrush-cheatgrass areas on steep slopes within the impact area of influence, including West Mountain and the Wasatch Front (Shields and Moretti 1982). Wild turkeys (*Meleagris gallopavo*) have been introduced into several canyons in the impact area of influence including the Diamond Fork and Hobble Creek drainages, Spanish Fork Canyon, and Payson Canyon. In the Diamond Fork drainage, turkeys introduced from the Rio Grande forage in side canyons, such as Red Hollow, and within meadows along riparian woodlands.

3.5.5.2.6 Passerine (Perching) Birds and Related Species. A variety of passerine birds and related species, including many neotropical migrants, occupy habitats within the impact area of influence. Conversion of native grasslands and brushlands to agriculture has likely had a profound adverse effect on the avian species assemblage compared to historical use patterns. Riparian habitats adjacent to streams, sloughs, lakes, and ponds support species such as Bewick's wren (*Thryomanes bewickii*), hermit thrush (*Catharus guttatus*), warbling vireo (*Vireo gilvus*), yellow warbler (*Dendroica petechia*), rufous-sided towhee (*Pipilo erythrophthalmus*), song sparrow (*Melospiza melodia*), and northern oriole (*Icterus galbula*). Birds found in marshes and in other wetland areas include bank swallow (*Riparia riparia*), red-winged blackbird (*Agelaius phoeniceus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). Birds characteristic of foothill shrublands and woodlands include broad-tailed hummingbird (*Selasphorus platycercus*), northern flicker (*Colaptes auratus*), tree swallow (*Tachycineta bicolor*), scrub jay (*Aphelocoma coerulescens*), American robin (*Turdus migratorius*), and white-crowned sparrow (*Zonotrichia leucophrys*). Birds representative of open grassland and agricultural lands include western kingbird (*Tyrannus verticalis*), horned lark (*Eremophila alpestris*), black-billed magpie (*Pica pica*), common raven, European starling, vesper sparrow (*Pooecetes gramineus*), lark sparrow (*Chondestes grammacus*), western meadowlark (*Sturnella neglecta*), and American goldfinch (*Carduelis tristis*).

3.5.5.2.7 Small Mammals. A variety of small mammals occur throughout the impact area of influence, including vagrant shrew (*Sorex vagrans*), various bats (*Myotis* sp.), Botta's pocket gopher (*Thomomys bottae*), rock squirrel (*Spermophilus variegatus*), deer mouse (*Peromyscus maniculatus*), and meadow vole (*Microtus pennsylvanicus*).

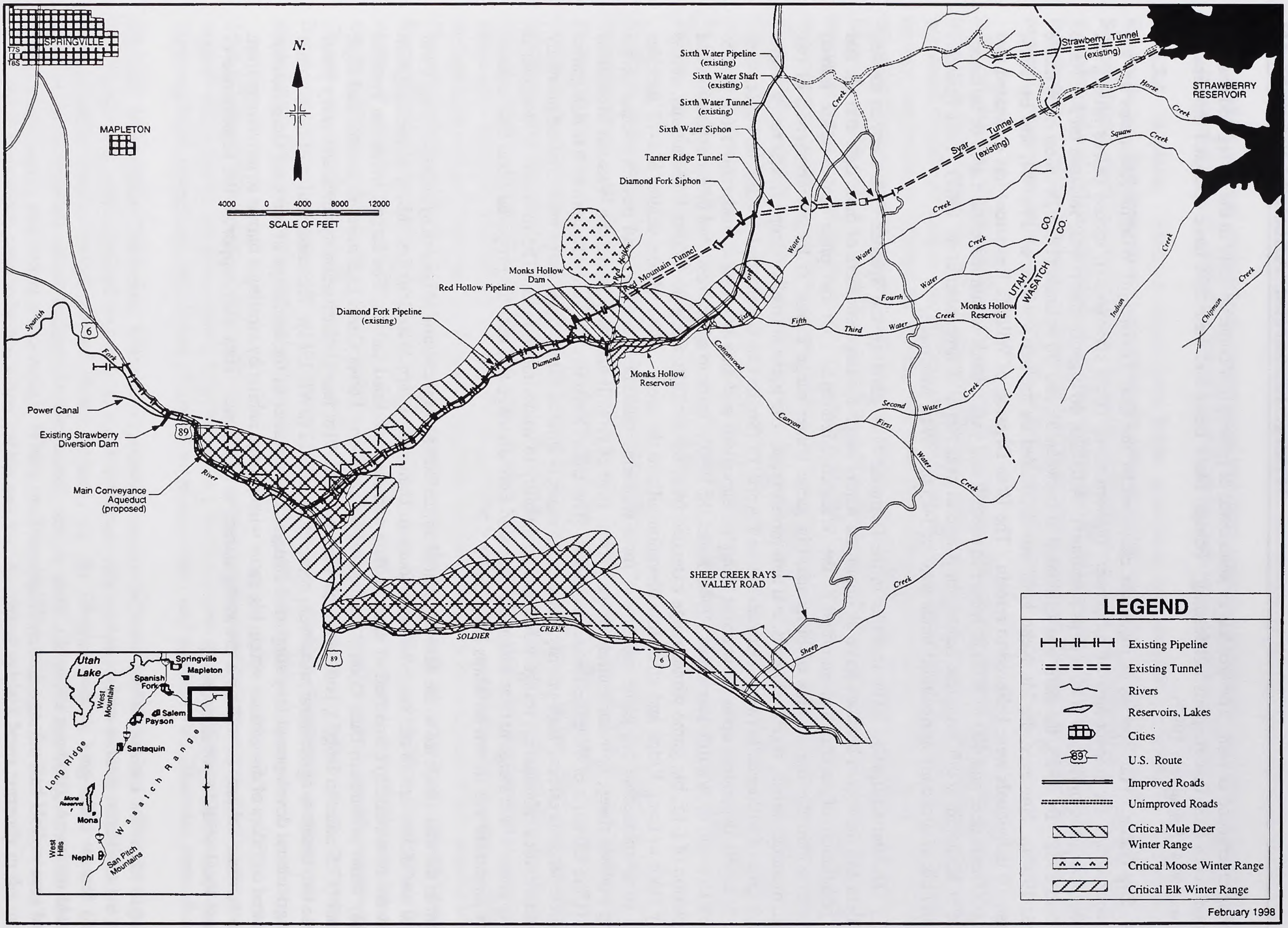
3.5.5.2.8 Mammalian Predators. Mammalian predators occupy different wildlife habitats within the impact area of influence (e.g., oak woodland, wetlands, or sagebrush/grass communities) where suitable conditions are present. Representative species include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), long-tailed weasel (*Mustela frenata*), mink (*Mustela vison*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), American black bear (*Ursus americanus*), and bobcat (*Felis rufus*). Within the Diamond Fork drainage, the Red Hollow area has been documented in previous years to be black bear habitat and may be critical to black bears currently in the mountain range (Sakaguchi 1997). The Red Hollow area is important not only for denning, but for late fall feeding and

early spring emergence as well. The area has an abundance of grasses that come up early in the spring and usually has a good acorn crop that supports fall feeding. Female black bears and their cubs have occupied the area as recently as 1994 (Sakaguchi 1997).

3.5.5.2.9 Big Game. Four species of mammals classified by the Utah Division of Wildlife Resources as "big game" occur within the impact area of influence: bighorn sheep (*Ovis canadensis*), moose (*Alces alces*), elk (*Cervus elaphus*), and mule deer (*Odecoileus hemionus*). A total of 48 bighorn sheep were released on Mt. Nebo in 1981 and 1982. By 1983, the herd was estimated at between 55 and 90 animals (Utah Division of Wildlife Resources 1994a). However, the Mt. Nebo herd was decimated by the harsh winter of 1983-84, and by 1994, fewer than 10 individuals were believed to remain. The Utah Division of Wildlife Resources has estimated that 600 to 1,000 mule deer and 400 to 700 elk winter in foothill and valley lands within the impact area of influence from Loafer Mountain south along the Santaquin Ridge to near Nephi (Christensen et al. 1987). Low numbers of deer and elk also occupy agricultural lands west of I-15 and West Mountain.

3.5.5.2.9.1 Habitat Utilization. The foothills in the Diamond Fork drainage and Spanish Fork Canyon as well as the Salem and Santaquin benches serve as important winter range for large numbers of mule deer and elk and a small population of moose that summer in the Wasatch Mountains. Of the plant and wildlife habitat communities within the impact area of influence, big game winter range habitat is largely comprised of oak woodland, mountain brush, sagebrush/grass, and bitterbrush/grass. Big game normally occupy winter range within the impact area of influence between December 1 and April 15 (Smith and Greenwood 1983a); however, their presence is highly dependent upon snow cover at higher elevations and may fluctuate considerably from year to year (Utah Division of Wildlife Resources 1994a, Fairchild 1995). Prior to agricultural and urban expansion and the completion of I-15, big game winter range extended from the foothills along the Wasatch Mountains, across the valley floor to Long Ridge and other low elevation hills to the west. Although the design of I-15 includes crossings to accommodate big game movement, most wintering mule deer and elk, and possibly some of the remaining bighorn sheep, now concentrate in the narrow strip of foothill habitat between the Wasatch Mountains and I-15 (Utah Division of Wildlife Resources 1993). The Utah Division of Wildlife Resources has designated most of these lands as critical, high-priority, substantial value, or limited value winter range habitat based primarily on their distribution, abundance, forage value, and availability to wintering animals. The locations of designated critical big game winter range habitat within the Diamond Fork drainage and near the proposed Main Conveyance Aqueduct alignment are shown on Maps 3.5-1 and 3.5-2.

Settlement in the mid-1800s led to the development of agriculture and agricultural irrigation systems to bring water from local and distant creeks and reservoirs into southern Utah and eastern Juab Counties. Many of the irrigation systems were (and remain) comprised of open earthen and concrete-lined canals. The largest irrigation systems that supply water to southern Utah County are the SVP's Strawberry Power Canal (3.3 miles in length) and High Line Canal (17.5 miles in length), both of which were built in 1916; lateral distribution systems that carry water from these two canals to agricultural areas were completed by 1922 (FWS 1981). The construction of these canals and the agricultural development they supported changed the character of the landscape in southern Utah County. They created corridors of disturbance within big game winter range habitat by creating a barrier to movement from winter to summer habitat, as well as a drowning hazard to big game. They also supported the coexistence of human and local wildlife populations.



Map 3.5-1
Critical Big Game Habitat within the Diamond Fork Drainage

Wildlife crossings were created for both I-15 and the irrigation canals. Initially, use of the crossings was limited; however, studies have shown that use of the I-15 undercrossings has increased substantially since initial observations were made in 1975 (Smith and Greenwood 1983a; Christensen et al. 1987). The Strawberry Power and High Line Canals also have crossings that allow big game to access lands to the west. However, a number of animals are lost every year to drowning as a result of attempting to cross or drink from the canals or from being chased and harassed. Escape is unlikely if the side slopes have a horizontal-to-vertical ratio greater than 2:1 or if the water level is 12 inches or more below the top of the canal, especially if the canals are concrete-lined (Smith and Greenwood 1983a). The side slopes of both the Strawberry Power Canal and the High Line Canal are 1.5:1 (FWS 1981). In 1983, it was reported that an average of 20 dead deer are removed annually from the canal system at a screen at the power house in the mouth of Spanish Fork Canyon, 10 between the power house and Rocky Ridge, and an additional 15 near Spring Lake. In 1995, the SWUA reported finding a total of 15 dead deer in the two canals (Ogborn 1996). Elk losses have also been recorded in these canals.

3.5.5.2.9.2 Crop Depredation. Big game depredation of croplands west of I-15 is a major concern of the Utah Division of Wildlife Resources. Most crop depredation occurs during the winter months as deer and elk migrate across Juab Valley to and from winter range habitat in the western foothills, although some feeding occurs within agricultural areas throughout the year. About 55 percent (i.e., 44 of 81) of landowner complaints originated from the Mona and Nephi areas, where potentially affected agricultural lands are located (Christensen et al. 1987). Complaints from affected landowners have been handled by the Utah Division of Wildlife Resources through payment for crop losses, fencing of haystacks, herding depredating animals, providing aversive devices to landowners, and killing of specific animals. For example, from 1979 to 1987, 898 deer were killed during selective hunts, and an additional 14 deer and one elk were taken by the Utah Division of Wildlife Resources following a specific complaint.

3.5.5.2.10 Wetland-Associated Wildlife. The wetland communities present within the impact area of influence, as identified in Section 3.5.5.1.5, provide a range of habitat values for a diverse assemblage of amphibians, reptiles, birds, and mammals. Of the 11 wetland community types identified within the impact area of influence, seven are of primary importance for feeding, breeding, and nesting. Wetland communities of primary importance to wildlife groups are identified in Table 3.5-1.

3.5.6 Impact Analysis

The following categories were used to identify impacts that would result from the Proposed Action and alternatives:

- **Construction Impacts.** Construction activities that would directly impact wildlife include removal and disturbance of vegetation, soil, and other habitat elements; disturbance to wildlife that could alter their normal behavior; and disturbance that could result in mortality and/or diminished health of animals. Indirect impacts include removal of animals depredating croplands and increased predation resulting from loss of escape cover.

- **Operation Impacts.** Operational activities that would impact wildlife include periodic surveys and maintenance of facilities, weed abatement, increased access for recreational activities, and changes in land and water management.

Table 3.5-1
Wetland Communities of Primary Importance to Wildlife Groups Located Within the SFN System Impact Area of Influence*

Wildlife Groups	Marsh	Wet Meadow/ Marsh	Riparian Forest	Riparian Shrub	Saline Playa	Creek Bed/ Riverine	Aquatic Bed/ Open Water
Amphibians	✓	✓				✓	
Reptiles	✓	✓	✓	✓		✓	
Waterbirds	✓	✓				✓	✓
Raptors	✓	✓	✓		✓	✓	✓
Passerine Birds	✓		✓	✓			
Small Mammals	✓						
Mammalian Predators	✓	✓		✓			

*Primary importance for feeding, breeding, and nesting.
Note: Whereas wet meadow, saline meadow, saline wet meadow/marsh, and spikerush mudflat wetland communities are important habitats for wildlife within the impact area of influence, they are not used as primary feeding, breeding, and nesting areas. None of the 11 wetland areas within the impact area of influence are of primary importance to upland game birds.

The duration of an impact to wildlife is important when determining the significance of a project-related action on wildlife. The following definitions apply to the discussion of duration of impacts:

- **Temporary Impacts**. Impacts are considered temporary if the affected resource would recover from impacts within 3 years following construction activities.
- **Long-Term Impacts**. Impacts are considered long-term if the affected resource would eventually recover, but not within 3 years following construction.
- **Permanent Impacts**. Impacts are considered permanent if the affected resource would not recover.

3.5.6.1 Significance Criteria

Potential impacts to wildlife resources that could result from construction and operation of the SFN System and related actions are considered significant if any one of the following conditions should occur:

- Activities cause substantial disturbance to wildlife. A substantial disturbance is one that destroys a large area of utilized habitat, disturbs or displaces a resident population (sub-population), or results in losses of large numbers of individuals of the species. Substantial disturbance is based on the status, population dynamics, behavior, habitat availability, and habitat quality for each species or species group (e.g., upland game birds) relative to the type, intensity, and duration of a specific impact. For example, species that are locally common (e.g., Brewer's blackbird) or have a high reproductive potential and the ability to recolonize disturbed sites rapidly (e.g., deer mouse) would not be significantly affected by SFN System impacts in the same manner as endangered species.

- Activities cause the loss (temporary or permanent) or unavailability of "critical" big game winter range habitat (as officially designated by the Utah Division of Wildlife Resources) from December 1 to April 15.

- Actions cause a substantial change in the total wildlife habitat value of an on-farm representative area for any species, based on the rating system described in the on-farm approach (see the *Wildlife Resources Technical Report* [CUWCD 1998e]). According to the rating system, "substantial" is defined as a change of 0.3 or greater on a scale of 0.0 to 1.0, where:

1.0	=	Optimum Habitat Value
0.7 - 0.9	=	Good Habitat Value
0.4 - 0.6	=	Fair Habitat Value
0.1 - 0.3	=	Poor Habitat Value
0.0	=	No Habitat Value

  Thus, a 0.3 change in a rating at any level would drop or raise a value to another level. Such changes indicate an impact that needs to be evaluated against the first criterion presented above.

3.5.6.2 Potential Impacts Eliminated from Further Analysis

No potential impacts have been eliminated from further analysis.

3.5.6.3 Proposed Action

The following sections describe the construction- and operation-related impacts that would result from the Proposed Action. These impacts are summarized in Section 3.5.6.10.

3.5.6.3.1 Construction Impacts. The following sections identify and discuss the significance of construction-related impacts.

3.5.6.3.1.1 Vegetation/Wildlife Habitats. The area of wildlife habitat that would be disturbed, permanently lost, or converted to another habitat type as a result of construction of the Proposed Action is shown in Table 3.5-2. For the purpose of this analysis, the "area of total disturbance" is defined as the area that would be disturbed (temporarily and permanently) by construction activities. The "area of permanent habitat loss" is defined as areas that would permanently lose habitat as a result of construction disturbance or the siting of permanent facilities. The areas identified as permanent habitat type conversion would be replanted and would convert into another vegetation/habitat community type. Wetlands that would convert to a non-vegetated wetland community type (e.g. riparian shrub to creek bed/riverine) are included in this category.

As identified in Table 3.5-2, a total of 1,231.0 acres of wildlife habitat would be disturbed. Of this amount, 139.4 acres would be permanently lost as a result of the construction of permanent facilities and the filling in of the High Line Canal, leaving 1,091.6 acres (1,231.0 minus 139.4) to be revegetated.

A total of 176.5 acres of pre-construction wildlife habitat would be revegetated, but permanently converted to another habitat type. Specifically, the restoration objectives identified in Table 3.5-2 would result in the conversion of three community types: oak woodland, pinyon/juniper, and wetlands (riparian). Oak woodland and pinyon/juniper communities would be converted to a grass/shrub community since no trees would be allowed to grow within the permanent right-of-way to comply with pipeline maintenance requirements. Wetland (riparian) habitat would be converted to a grass/forb/shrub community for the same reason. Consequently, construction of the Proposed Action would result in a permanent conversion of 166.9 acres of oak woodland, 8.5 acres of pinyon/juniper, and 0.2 acre of wetland habitat.

Table 3.5-2
Area of Wildlife Habitat Disturbance Resulting from the Proposed Action[a]

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss[b] (acres)	Wildlife Habitat Restoration Objectives		Area of Permanent Habitat Type Conversion (acres)
			Temporary (1-3 years)	Permanent (3+ years)	
"Diamond Fork Tunnel Alternative"					
Sagebrush/Grass	23.9	0.0	Grass/forb	Sagebrush/grass	0.0
Wetlands[c]	0.6	0.0	Grass/shrub	Grass/forb/shrub	0.2[d]
Mountain Brush	103.5	33.5	Grass/forb	Mountain brush	0.0
Aspen/Conifer	0.0	0.0	NA	NA	0.0
Subtotal	**128.0**	**33.5**			**0.2**
Main Conveyance Aqueduct and Associated Facilities					
Oak Woodland	173.9	7.0	Grass/forb	Grass/shrub	166.9
Sagebrush/Grass	589.4	49.1	Grass/forb	Sagebrush/grass	0.0
Bitterbrush/Grass	9.0	2.0	Grass/forb	Bitterbrush	0.0
Pinyon/Juniper	8.5	0.0	Grass/forb	Grass/shrub	8.5
Wetlands[c]	2.5	1.2	Grass/shrub	Grass/forb/shrub	0.9[e]
Agricultural Land	222.0	33.6[f]	Cultivated	Cultivated	0.0
Previously Disturbed	97.7	13.0	Grass/forb	Grass/shrub	0.0
Subtotal	**1,103.0**	**105.9**			**176.3**
Totals	**1,231.0**	**139.4**			**176.5**

[a]These acreages include temporary and permanent disturbances for construction of the "Diamond Fork Tunnel Alternative," Main Conveyance Aqueduct, recreation trail, turnouts, regulating ponds, equalization reservoirs, Main Conveyance Reservoir, and West Mona facilities.
[b]Includes loss of 13 acres of open water habitat within the primarily concrete-lined High Line Canal. For the purposes of this analysis, this area was classified as previously disturbed habitat and not as wetland.
[c]See Table 3.4-3 in Section 3.4, Wetland Resources, for a breakdown of specific impacted wetland community types.
[d]This wetland habitat at the Diamond Fork Creek crossing for the Diamond Fork Siphon would be revegetated, but not to riparian habitat.
[e]This permanent conversion would be a result of operation of the Main Conveyance Aqueduct.
[f]This area represents orchards that would be lost during the construction of the Main Conveyance Aqueduct.

Temporary and long-term disturbance to 1,231.0 acres of wildlife habitat is not considered a significant impact because the disturbance would occur incrementally over a 10-year period, the majority of habitat would be restored to pre-construction conditions, and the affected habitats are abundant in the impact area of influence. Long-term impacts would be limited to sagebrush/grass and bitterbrush/grass habitats, as revegetation to pre-construction conditions (i.e., similar to adjacent habitats in terms of shrub density, cover height, and composition) would likely take many years.

The permanent loss of 139.4 acres of wildlife habitat would not be a substantial acreage loss when compared to available habitat within the impact area of influence. However, approximately 70.7 acres out of the 139.4 acres

include oak woodland and sagebrush/grass vegetation that is designated critical big game winter range habitat (see Table 3.5-3). According to the significance criteria, a permanent loss of critical big game winter range would be a significant impact. A discussion of impacts associated with disturbance to critical big game winter range habitat is presented in Section 3.5.6.3.1.3.

As identified in Table 3.5-2, 3.1 acres of wetland habitat would be temporarily disturbed as a result of the construction of the Proposed Action (see Section 3.4 for a discussion of how these acreages were calculated). The majority of this disturbance would occur to riparian shrub habitat, a habitat type of primary importance to reptiles, passerine birds, and mammalian predators. It is not likely that the permanent loss of 1.2 acres of wetland habitat would cause a significant impact to wildlife. However, under the significance criteria established in Section 3.4, Wetland Resources, the loss of this habitat is considered significant.

3.5.6.3.1.2 General Wildlife. Clearing, grading, and trenching for the Proposed Action would result in direct mortality to certain amphibians and small mammals that are unable to quickly disperse from construction areas. Other animals would escape construction areas and be displaced into surrounding habitats, where available. Disturbed areas that are revegetated following construction would be recolonized through immigration of new animals from adjacent habitats within 1 to 3 years. These impacts to amphibians and small mammals are not considered significant because most of the species that would be affected are locally and regionally common; construction would occur incrementally over a 10-year period; relatively few individuals of any species would be affected; and the continued existence of species within southern Utah and eastern Juab Counties would not be substantially disturbed.

Open trenches would create a temporary hazard to amphibians and small mammals and a barrier to their movement. However, several strategies would be used to reduce this impact, including limiting the length of open trench to no more than 600 feet at any time. Trenches would also be backfilled or covered at the end of each day and inspected for trapped animals prior to backfilling.

Specific construction-related impacts to reptiles, waterbirds, raptors, upland game birds, passerine birds and related species, mammalian predators, and big game are presented below.

Reptiles. During construction, it is possible that reptile dens may be encountered along the alignment of the "Diamond Fork Tunnel Alternative." Reptile dens could be destroyed during construction activities. To avoid impacts to reptile dens, the CUWCD would comply with provisions of Certificates of Registration issued by the Utah Division of Wildlife Resources. According to the Utah Division of Wildlife Resources, the Certificates of Registration would include provisions that require the Utah Division of Wildlife Resources be notified when reptile dens are encountered to allow collection of individuals and eggs in the den (Sakaguchi 1997).

Waterbirds. The Proposed Action facilities would avoid most wetland communities preferred by waterbirds such as ducks, geese, shorebirds, and wading birds. A total of 1.2 acres of wetland habitat would be permanently lost as a result of the construction of the Proposed Action. This loss would not substantially disturb waterfowl and would not cause a significant impact to wildlife resources.

Raptors. Construction activities could temporarily disturb nesting raptors within 1.0 mile of Proposed Action facilities. Construction disturbance could result in nest abandonment, loss of eggs and young, and a resulting short-term decline in recruitment of raptor populations. Raptors commonly found in the Diamond Fork drainage, such as red-tailed hawks, prefer to nest in large trees within riparian habitat and forage in grasslands. Such habitats within the Diamond Fork drainage are relatively undisturbed. During construction of the Diamond Fork Siphon, the Proposed Action would impact 0.2 acre of riparian habitat (see Table 3.4-3), which would not be a substantial disturbance. Temporary and permanent loss of foraging habitat would not be a significant impact as grassland habitats are common in the area. Main Conveyance Aqueduct facilities would be primarily located near

existing residential communities, highways, railroads, and other sources of disturbance that currently deter many raptors from nesting; thus, construction in these areas would not cause a significant impact to raptors.

Upland Game Birds. Construction of the Proposed Action would result in permanent and temporary impacts to foraging habitat for upland game birds, particularly wild turkeys, present in the impact area of influence. The loss of foraging habitat (primarily sagebrush/grass, mountain brush, and agricultural lands) would not be significant since suitable foraging habitat for these species could be found outside of construction areas. Clearing and grading activities could result in the loss of nests, eggs, and young of the few birds that may nest in construction sites. These impacts would not cause a substantial disturbance to upland game bird populations as few birds would be affected and habitats within the proposed construction sites are of low value to most upland game birds. In addition, temporarily disturbed habitat would be regraded and reseeded following completion of construction activities. The CUWCD would consult with the USFS and Utah Division of Wildlife Resources to develop a revegetation seed mix with species that would benefit wild turkey foraging habitat in the Diamond Fork drainage.

Passerine Birds and Related Species. Construction of the Proposed Action would result in both permanent and temporary loss of breeding and foraging habitat for passerine birds and related species in the impact area of influence. The loss of foraging habitat in wetlands, agricultural lands, mountain brush, and sagebrush/grass habitats would not be significant, as suitable foraging habitat for these species is abundant in the region. Disturbance of nesting birds could result from clearing and grading operations and cause the loss of a limited number of nests, eggs, and young. These impacts would not be significant as few birds would be affected, most of the species affected are locally and regionally common, and the continued existence of these species within southern Utah and eastern Juab Counties would not be substantially disturbed.

Mammalian Predators. Most mammalian predators, such as skunks and coyotes, that occur within the impact area of influence have large home ranges and are highly mobile, thus enabling them to avoid construction activities. Impacts to these species would not be significant as few individuals would be affected, most species are locally common and widespread, and prey populations would not be substantially disturbed.

Black bear habitat in the Red Hollow area of the Diamond Fork drainage could be impacted by construction activities associated with the Red Mountain Tunnel outlet. Construction disturbances could result in the loss of denning and foraging habitat and displacement into adjacent ranges. This displacement could result in increased competition between individuals. At this time, insufficient data exist regarding black bear activity in the Red Hollow area to quantify construction impacts. The Utah Division of Wildlife Resources has recommended monitoring black bears in Red Hollow, possibly through a radio-collar program, to gather more information on potential construction impacts (Sakaguchi 1997). The CUWCD would consult with the Utah Division of Wildlife Resources regarding potential monitoring.

3.5.6.3.1.3 Big Game. Construction of the Proposed Action would result in impacts to critical winter range habitat for mule deer and elk in the Diamond Fork drainage and in southern Utah and eastern Juab Counties as summarized in Table 3.5-3. Construction would not occur in the sensitive period of December 1 through April 15; the majority of the area would be revegetated; and disturbance would occur over a 10-year period. Tunnel drilling, pipeline excavation, and construction traffic would increase noise levels in critical big game winter range and would be scheduled to occur in the summer months following snowmelt. Since construction would be limited by accessibility, the majority of big game would move to higher ground before construction activities commence in work areas within critical winter range. Construction activities within critical big game winter range would not result in a significant impact as these habitats would not be lost or unavailable in the impact area of influence from December 1 to April 15.

Table 3.5-3
Areas of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting from the Proposed Action

Critical Winter Range	Location by Distance Marker or Feature	Distance (linear feet)	Right-of-Way Width (feet)	Temporary Disturbance (acres)	Permanent Disturbance (acres)
"Diamond Fork Tunnel Alternative"					
Mule Deer Only	Red Hollow Pipeline[a]	17,000	90 (average width)	30.6	10.7
Main Conveyance Aqueduct and Associated Facilities					
Dual Use	37,500-45,000	7,500	200	110.5	6.0
	91,000-107,500	16,500	200		
Mule Deer Only	45,000-53,000	8,000	200	310.3[b]	54.0
	85,000-91,000	6,000			
	118,000-163,000	45,000			
	218,000-225,000	7,000	120		
Elk Only	300-10,000	9,700	90 (average width)	55.0	0.0
	32,500-37,500	5,000	200		
	107,500-110,000	2,500	200		
Subtotal				**475.8**	**60.0**
Total Area				**506.4**	**70.7[c]**

[a]This disturbance includes construction of Red Hollow Pipeline and the access road.
[b]This includes 20.3 acres of temporary disturbance associated with the four Mona Pipeline spur lines.
[c]This total is comprised of impacts associated with the Red Hollow Pipeline; the recreation trail from distance marker 39,000 to 53,000 and 85,000 to 94,000; regulating ponds SU7, EJ3, and EJ4; one equalization reservoir, and the Main Conveyance Reservoir.
Source for Main Conveyance Aqueduct and associated facilities: Barney 1994.

Permanent loss of 70.7 acres of critical big game winter range habitat (i.e., oak woodland, sagebrush/grass, bitterbrush/grass) would be attributed to the Red Hollow pipeline, the recreation trail, three regulating ponds, the Main Conveyance Reservoir, and an equalization reservoir. This loss would be significant since the habitat would be unavailable for use by big game.

In the Diamond Fork drainage, big game species use the upper portion of Red Hollow (near the proposed Red Mountain Tunnel outlet and upper Red Hollow pipeline) as a migration route in the early spring and late fall. Construction activities could impact the route during fall migration by disturbing wildlife moving through the corridor. Construction activities would not occur in this area from December 1 to April 15; therefore, spring migration would not be affected. Construction activities during fall migration could result in a substantial disturbance to wildlife moving through the corridor. Based on the significance criteria discussed in Section 3.5.6.1, a substantial disturbance to wildlife would be considered a significant impact. The CUWCD would coordinate with the Utah Division of Wildlife Resources to minimize impacts during fall migration to the extent practicable.

3.5.6.3.2 Operation and Maintenance Impacts. This section discusses the impacts that would occur as a result of operation of the Proposed Action.

3.5.6.3.2.1 Vegetation/Wildlife Habitats. Weed abatement would be conducted to inhibit the establishment of vegetation within facilities rights-of-way and along the recreation trail. This vegetation maintenance would not affect any important wildlife habitats, would not be measurable, and would not be a significant impact.

Under the Proposed Action, operation of the Main Conveyance Aqueduct would result in the permanent conversion of 0.9 acre of wetland habitat (see Table 3.4-4). This conversion would be considered a significant impact to wetland resources; however, permanent conversion of 0.9 acre of wetland habitat would not be a significant disturbance to wildlife.

3.5.6.3.2.2 General Wildlife. Operation and maintenance of the Proposed Action could impact wildlife by increasing human activity in wildlife habitat areas within the impact area of influence. Maintenance (e.g., weed control, facility site inspections) would occur on a periodic basis; however, these activities would not cause a substantial disturbance to wildlife.

The 14.3-mile recreation trail that would be constructed under the Proposed Action would be located within the Main Conveyance Aqueduct alignment where the High Line Canal would be replaced. An estimated 35,000 people would use the recreation trail each year, with most use occurring in the spring and summer months (see Section 3.10). Motorized use of the trail would not be authorized, and it is anticipated that winter use of the trail (when deer or elk may be located in the general vicinity) would be less than spring and summer use. The trail would be located in a populated area of southern Utah County that currently experiences activities associated with trail use (e.g., biking, horseback riding, and running).

Impacts to wildlife as a result of recreation trail use would not likely be significant. That is, partially paving the existing High Line Canal alignment and authorizing restricted use of the alignment would not result in a substantial disturbance to wildlife within the impact area of influence. Although a limited amount of wildlife habitat would be removed as a result of the construction of the Main Conveyance Aqueduct and the recreation trail, a portion of the recreation trail would be revegetated. In addition, the elimination of a drowning hazard that results in a loss of at least 15 deer per year would be beneficial. The increase in human activity that would occur as a result of the recreation trail would not likely create a substantial disturbance to wildlife already accustomed to disturbances associated with farming activities, vehicle use, and residential maintenance.

3.5.6.3.2.3 Big Game. Impacts to big game could be caused by operation and maintenance activities associated with the Proposed Action, including some that would be caused by increases in crop productivity in the agricultural lands that would receive a Bonneville Unit water supply. Specifically, the location of the Main Conveyance Reservoir could attract big game as a potential water supply. As described in Chapter 1, Section 1.6.2.5, the reservoir would be fenced to prevent drownings. Maintenance activities would be limited to monthly site inspections and would not result in substantial disturbance.

Replacement of the High Line Canal with the buried Main Conveyance Aqueduct would benefit wildlife by eliminating a potential drowning hazard and reducing a barrier to movement. It can be assumed that big game mortality associated with canal drownings (15 in 1995 [Ogborn 1996]) would be eliminated. Filling in the canal would not completely eliminate impacts associated with a linear corridor, such as movement restrictions, but it would provide some level of unquantifiable benefit. For example, the alignment would be partially revegetated and would allow safer access to lands on the west side of the valley. Because the Main Conveyance Aqueduct alignment lies within a populated area and other linear corridors would remain (e.g., I-15), restoration of the habitat to historical conditions would not be possible.

Increases in crop yields and multiple crops per year spread over a larger area (see Section 3.9, Agriculture) could lead to increased levels of crop depredation by wildlife, especially wintering deer and elk. Increases could result simply because of the availability of and access to a larger number of crops. Depredating animals may be harassed, killed by landowners or by the Utah Division of Wildlife Resources, or driven back onto critical winter

range areas east of I-15 where forage may be inadequate to support winter-stressed animals. Mortality levels are likely to increase marginally, although the exact number of animals affected is not quantifiable and would vary over time, depending on annual variations in cropping patterns on farms accessible to big game, availability and quality of forage on native rangeland, herd size, and weather, among other factors. The potential increase in mortality would not likely result in a substantial disturbance to deer and elk in southern Utah and eastern Juab Counties, and therefore, the impact would not be significant.

3.5.6.3.2.4 Wetland-Associated Wildlife. Operation and maintenance of the Proposed Action could impact wetland-associated wildlife by increasing human activity in wildlife habitat areas within the impact area of influence. Maintenance of facilities under the Proposed Action would occur on a periodic basis. These activities would not cause a substantial disturbance to wetland-associated wildlife.

Water quality impacts on wetland wildlife would not be significant, as the average salinity levels are expected to remain well under the levels (estimated 4,500 to 5,000 ppm of TDS) at which adverse effects would occur to amphibians, nesting waterfowl, and other wetland species.

3.5.6.3.3 Related Actions (Local Development). The following sections describe the construction- and operation-related impacts to wildlife that would result from local development related to the Proposed Action. These impacts are summarized in Section 3.5.6.10.

3.5.6.3.3.1 Local Distribution Systems. The amount of wildlife habitat that would be disturbed as a result of constructing and operating the M&I and irrigation distribution systems is summarized in Table 3.5-4. A total of 791.5 acres would be temporarily disturbed. Of this amount, 26.8 acres would be converted. This includes 6.4 acres of wetlands associated with the M&I systems and 15.3 acres of wetland habitat associated with the irrigation distribution systems. The remainder of disturbed habitat consists of agricultural and previously disturbed lands that would either be returned to agricultural production, revegetated, or covered with asphalt and/or concrete.

The wetland and previously disturbed land provide a limited resource for foraging, escape, resting, and movement between fragmented habitats. However, the majority of the disturbance would be temporary, would occur incrementally over a 5-year period, and would not affect all available habitat. Impacts would not be significant because they would not cause a substantial disturbance to wildlife. The replacement of open ditches with pipeline would eliminate a potential water source. However, the frequency at which the existing ditches are being used to convey water is not reliable, and the elimination of this potential water source would not create a significant impact to wildlife.

3.5.6.3.3.2 On-Farm System. Wildlife values of agricultural areas representative of those within the impact area of influence were assessed using a set of seven On-Farm Habitat Utilization Guides (CUWCD 1998h). These guides were established as part of the on-farm approach described earlier in Section 3.5.5.1.6 and presented in more detail in the *Wildlife Resources Technical Report* (CUWCD 1998e). The guides address the extent to which agricultural lands provide the specific habitat needs of the following wildlife groups: amphibians, reptiles, waterbirds, raptors, upland game birds, passerine birds and related species, small mammals, and mammalian predators.

Agricultural lands have relatively low wildlife value. Conversion from one cropping type or irrigation practice to another would not be expected to have a significant effect on existing wildlife. However, an analysis was completed to predict effects by comparing various croplands. In cases where no changes in irrigation practices or crop rotation are anticipated, no comparison was made. This is the case for about 28 percent of the farmland area.

Table 3.5-4
Area of Wildlife Habitat Disturbance Associated with Related Actions Resulting from the Proposed Action and MCAP Alternative

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Habitat Conversion (acres)
M&I Water Distribution Systems[a]		
Asphalt/concrete	257.6	0.0
Wetlands	6.4	6.4
Previously disturbed	58.0	0.0
Subtotal	**322.0**	**6.4**
Irrigation Distribution Systems		
Existing canal	131.1	118.0
Agricultural land	509.5	81.5
Sagebrush/grass	39.8	9.0
Oak woodland	0.2	0.1
Wetland[b]	15.3	15.3[c,d]
Developed land	97.5	24.8
Subtotal	**793.4**	**248.7**
Total	**1,115.4**	**255.1**

[a]See Table 2 in the M&I Representative Area Template (Appendix C).
[b]Includes 0.9 acre of riparian habitat that would be removed as a result of the EJWEP, which would be constructed prior to the Main Conveyance Aqueduct.
[c]This habitat would convert to upland habitat. See Table 3.4-5 for a breakdown of acreage.
[d]Includes 2.5 acres of wetland impact resulting from operation of the Salt Creek facilities.

Five agricultural land types comprising approximately 72 percent of the farmland were compared against cropland improvement that would occur as a result of the application of Bonneville Unit water. As a result, it is estimated that two of these cropland conversions were estimated to have significant effects on wildlife species (see Table 3.5-5). Raptor, upland game bird, and reptile/amphibian habitat were considered to be significantly affected on a localized scale, but the impacts were not considered significant on a regional scale.

3.5.6.3.4 Mitigation. To mitigate for the permanent loss of 70.7 acres of critical big game winter range habitat, the CUWCD would participate in the Utah Division of Wildlife Resource's Winter Range Acquisition Project. As a project participant, the CUWCD would acquire high priority lands at a 2 to 1 disturbance ratio (for a total of 141.4 acres) in the North Nebo Wildlife Management Area. These lands would be purchased either in fee or via conservation easement. The objective of this mitigation measure would be to reduce impacts to critical winter range to insignificant levels.

The implementation of this mitigation measure would not result in negative impacts to other environmental resources. In fact, it would indirectly benefit other wildlife species by setting aside land "in perpetuity" for the purpose of wildlife habitat. Landowners would be compensated for their property at fair market value. With recent population increases and population growth projected by both State and local agencies, this action would contribute to the Utah Division of Wildlife Resources' long-term goals of establishing permanent big game winter range areas. Big game habitat acquisition, in addition to construction avoidance between the months of December and April, limited operation-related disturbances, and revegetation of disturbed areas, would reduce impacts to big game from significant to not-significant.

Table 3.5-5
Summary of Impacts to Wildlife Habitat on Agricultural Lands Within the Impact Area of Influence

Existing Cropland	Future Cropland	Percentage of Agricultural Land Type	Wildlife Affected	Significance
Unimproved flood irrigation	Improved flood irrigation	30.0	No change	Not significant; no species category should change
Unimproved flood irrigation	Sprinkler irrigation	20.0	No change	Not significant; no species category should change
Flood irrigation	Sprinkler irrigation	7.5	Reptile/amphibians (-) Birds-water and passerine (-)	Not significant; slight loss
Unirrigated dryland crops	Sprinkler irrigation	13.0	Passerine birds (+) Mammalian predators (+)	Not significant; slight improvement
Alfalfa	Orchard	<1.0	Reptiles/amphibians (+) Raptors (-) Upland game birds (+) Passerine (+) Small mammal (+) Mammalian predators (+)	Not significant
Grassland and small shrubs	Sprinkler irrigation	1.0	Reptile/amphibians (-) Raptors (-) Upland game birds (-) Passerine birds (-) Mammalian predators (-) Small mammals (-)	Impacts to reptile/ amphibians, raptors, and upland game birds are considered significant localized impacts
Grassland and small shrubs	Orchard	1.0	Raptors (-) Mammalian predators (-)	Loss of raptor habitat is considered a significant localized impact

To mitigate impacts to wetland habitat to a not-significant level, a wetland mitigation plan would be implemented to avoid, create, and/or enhance existing wetland communities in the impact area of influence (see Section 3.4 for more detail on the proposed wetlands mitigation plan). This mitigation, coupled with increased spring discharges that would likely expand wetlands, especially in the headwater area of Currant Creek near West Creek, would effectively reduce wildlife disturbance to a not-significant level. Expansion of wetland habitat within the impact area of influence could benefit wetland-associated wildlife species by stabilizing or increasing the size of existing wetland habitats. This benefit would be most noticeable under drought conditions when wetlands would otherwise be more severely stressed.

Terrestrial mitigation for the Diamond Fork System included mitigation for impacts that would result from construction of Monks Hollow Reservoir. Most of the mitigation has been completed by the USBR; therefore, the USBR (or the CUWCD) may be eligible to receive a mitigation credit under the Proposed Action, since Monks Hollow Reservoir would not be constructed. The CUWCD would work with the USBR and FWS to determine if this credit is available and if it could be applied to terrestrial impacts of the SFN System. If such credit were applied, the mitigation plan would be adjusted accordingly.

3.5.6.3.5 Unavoidable Adverse Impacts. There would be no unavoidable adverse impacts associated with the Proposed Action if the mitigation is implemented and fully successful.

3.5.6.4 MCAPW-DFT Alternative

The following sections describe the construction- and operation-related impacts that would result from the MCAPW-DFT Alternative. These impacts are summarized in Section 3.5.6.10.

3.5.6.4.1 Construction Impacts. The following sections identify and discuss the significance of construction-related impacts. The area of pre-construction wildlife habitat that would be disturbed, permanently lost, or converted to another habitat type as a result of construction and operation of the MCAPW-DFT Alternative is summarized in Table 3.5-6. Construction-related impacts that would result from the "Diamond Fork Tunnel Alternative" identified under the Proposed Action would be identical; thus, the following sections are limited to discussion of impacts that would result from construction of the Main Conveyance Aqueduct and associated facilities.

3.5.6.4.1.1 Vegetation/Wildlife Habitat. Under the MCAPW-DFT Alternative, the Main Conveyance Aqueduct would not replace the High Line Canal and would result in impacts to habitat as shown in Table 3.5-6. Temporary disturbance to wildlife habitat resulting from construction of the Main Conveyance Aqueduct under the MCAPW-DFT Alternative would total 1,100.7 acres. Of this amount, 87.7 acres of permanent habitat loss would occur.

As a result of the construction of the Main Conveyance Aqueduct and associated facilities, a total of 172.9 acres of wildlife habitat would be converted to another habitat type (grass/forb/shrub), including 164.4 acres of oak woodland and 8.5 acres of pinyon/juniper. As discussed previously, temporary disturbance to this habitat is not considered a significant impact because the disturbance would occur incrementally over a 10-year period, the area would be restored, and other suitable habitat would be available. Long-term impacts would be limited to sagebrush/grass and bitterbrush/grass habitat, as revegetation to pre-construction status would not occur for a number of years.

The 87.7 acres of permanent habitat loss would not be considered substantial when compared with the total available habitat; however, the loss of oak woodland and sagebrush/grass vegetation located in designated critical big game winter range habitat would be a significant impact. Section 3.5.6.4.1.3 provides a discussion of critical big game winter range impacts.

3.5.6.4.1.2 General Wildlife. Construction of the Main Conveyance Aqueduct outside the High Line Canal right-of-way would result in increased clearing, grading, and trenching activities over that required for the Proposed Action. However, the same avoidance techniques and best management practices described for the Proposed Action would be implemented. Potential impacts are not considered significant because they would not affect a substantial portion of any species habitat within the region and would not likely cause a substantial disturbance to wildlife populations within the impact area of influence.

3.5.6.4.1.3 Big Game. The impacts to big game that would result from construction of the MCAPW-DFT Alternative are summarized in Table 3.5-7. Construction would not occur during the sensitive period of December 1 through April 15. The majority of the area would be revegetated and disturbance would occur over a 10-year period. Impacts that would be associated with construction of the recreation trail under the Proposed Action would not occur under the MCAPW-DFT Alternative.

Under the MCAPW-DFT Alternative, a total of approximately 44 acres of critical big game winter range habitat would be permanently disturbed as the result of the construction of the Main Conveyance Aqueduct. This loss would be a significant impact to big game habitat.

Table 3.5-6
Area of Wildlife Habitat Disturbance Resulting from the MCAPW-DFT Alternative[a]

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss (acres)	Wildlife Habitat Restoration Objectives		Area of Permanent Habitat Type Conversion (acres)
			Temporary (1-3 years)	Long-Term (3+ years)	
"Diamond Fork Tunnel Alternative"					
Sagebrush/Grass	23.9	0.0	Grass/forb	Sagebrush/grass	0.0
Wetlands[b]	0.6	0.0	Grass/shrub	Grass/forb/shrub	0.2[f]
Mountain Brush	103.5	33.5	Grass/forb	Mountain brush	0.0
Aspen/Conifer	0.0	0.0	---	---	0.0
Subtotal	**128.0**	**33.5**			**0.2**
Main Conveyance Aqueduct and Associated Facilities					
Oak Woodland	173.9	9.5	Grass/forb	Grass/shrub	164.4
Sagebrush/Grass	585.3	41.4	Grass/forb	Sagebrush/grass	0.0
Bitterbrush/Grass	10.8	2.0	Grass/forb	Bitterbrush	0.0
Pinyon/Juniper	8.5	0.0	Grass/forb	Grass/shrub	8.5
Wetlands[b]	2.5	1.2	Grass/forb	Grass/forb/shrub	4.1[c]
Agricultural Land	222.0	33.6[d]	Cultivation	Cultivation	0.0
Previously Disturbed	97.7	0.0	Grass/forb	Grass/shrub	0.0
Subtotal	**1,100.7**	**87.7**			**177.0**
Totals	**1,228.7**	**121.2[e]**			**177.2**

[a]These acreages include temporary and permanent disturbances for construction of the "Diamond Fork Tunnel Alternative," Main Conveyance Aqueduct, turnouts, regulating ponds, equalization reservoirs, Main Conveyance Reservoir, and West Mona facilities.
[b]See Table 3.4-3 in Section 3.4, Wetland Resources, for a breakdown of specific impacted wetland community types.
[c]This permanent conversion would be a result of operation of the Main Conveyance Aqueduct.
[d]This area represents orchards that would be lost resulting from the placement of the Main Conveyance Aqueduct.
[e]The total acreage affected is greater than that noted in Table 1-28, Land Disturbance Resulting from the MCAPW-DFT Alternative, because the definition of wetland and orchard disturbance as it relates to wildlife habitat is different.
[f]This wetland habitat at the Diamond Fork Creek crossing for the Diamond Fork siphon would be revegetated, but not to riparian habitat.

Table 3.5-7
Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting from the MCAPW-DFT Alternative

Critical Winter Range	Location by Distance Marker or Feature	Distance (linear feet)	Right-of-Way Width (feet)	Temporary Disturbance (acres)	Permanent Disturbance (acres)
"Diamond Fork Tunnel Alternative"					
Mule Deer Only	Red Hollow Pipeline[a]	17,000	90 (average width)	30.6	10.7
Main Conveyance Aqueduct and Associated Facilities					
Dual Use	37,500-45,000	7,500	200	110.5	0.0
	91,000-107,500	16,500	200		
Mule Deer Only	45,000-53,000	8,000	200	310.3[b]	44.0
	85,000-91,000	6,000			
	118,000-163,000	45,000			
	218,000-225,000	7,000	120		
Elk Only	300-10,000	9,700	90 (average width)	55.0	0.0
	32,500-37,500	5,000	200		
	107,500-110,000	2,500	200		
Subtotal				**475.8**	**44.0**
Total Area				**506.4**	**54.7[c]**

[a]This disturbance includes construction of Red Hollow Pipeline and the temporary access road.
[b]This includes 20.3 acres of temporary disturbance associated with the four Mona Pipeline spur lines.
[c]These ±44 acres are comprised of 7.8 acres associated with regulating ponds SU7, EJ3, and EJ4; 1 acre associated with one equalization reservoir; and 35 acres associated with the Main Conveyance Reservoir.
Source: Barney 1994

3.5.6.4.2 Operation and Maintenance Impacts. Operation and maintenance impacts would be similar to those identified for the Proposed Action with the exception of impacts to the High Line Canal between the communities of Spanish Fork and Santaquin, and impacts associated with the recreation trail. The recreation trail would not be built under the MCAPW-DFT Alternative; therefore, the potential impacts identified under the Proposed Action that would result from use of the trail would not occur.

Under the MCAPW-DFT Alternative, operation of the Main Conveyance Aqueduct would result in the permanent conversion of 4.1 acres of wetland habitat (see Table 3.4-6). This conversion would be a significant impact to wetland resources; however, permanent conversion of 4.1 acres of wetland habitat would not be a significant disturbance to wildlife. Maintenance activities such as patrolling the right-of-way and performing weed abatement tasks would not result in significant impacts to wildlife.

3.5.6.4.3 Related Actions (Local Development). Under the MCAPW-DFT Alternative, the construction and operation of the distribution pipelines would be less extensive than under the Proposed Action. No existing canals, including the High Line Canal, would be removed. On-farm system impacts would be the same as described under the Proposed Action.

3.5.6.4.3.1 Local Distribution Systems. A total of 940.5 acres would be temporarily disturbed, as shown in Table 3.5-8. Of this amount, 40 acres would be converted to grass/forb habitat after construction. Converting

the High Line Canal from an open water canal to a buried box culvert would eliminate approximately 13 acres of open water habitat. The loss of this water source would not cause a substantial disturbance to wildlife and is not considered a significant impact. The right-of-way would be revegetated, and the drowning hazard created by the open canal, resulting in the death of at least 15 deer per year, would be eliminated.

Table 3.5-8
Area of Wildlife Habitat Disturbance Associated with Related Actions Resulting from the MCAPW-DFT and MCAPW Alternatives

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Habitat Conversion (acres)
M&I Water Distribution Systems[a]		
Asphalt/concrete	257.6	0.0
Wetlands	6.4	6.4
Previously disturbed	58.0	0.0
Subtotal	**322.0**	**6.4**
Irrigation Distribution Systems		
Existing canal[b]	0.0	0.0
Agricultural lands	406.3	41.9
Sagebrush/grass	13.9	5.6
Oak woodland	1.9	1.8
Wetlands[c,d]	4.4	4.4[e]
Developed land	42.2	14.9
Subtotal	**468.7**	**68.6**
Total	**790.7**	**75.0**

[a]See Table 2 in the M&I Representative Area Template (Appendix C).
[b]Includes 13 acres of open water habitat within the primarily concrete-lined High Line Canal that would be lost from distance marker 39,000 to 94,000. For the purpose of this analysis, this area was classified as previously disturbed habitat and not as wetland habitat.
[c]Includes the loss of 0.9 acre of wetland habitat that would result following construction of the EJWEP prior to the Main Conveyance Aqueduct.
[d]This habitat would convert to upland habitat. See Table 3.4-5, Section 3.4, Wetland Resources, for a breakdown of acreage.
[e]Includes 2.5 acres of wetland impact resulting from operation of the Salt Creek facilities.

3.5.6.4.4 Mitigation. The same mitigation measures that would be applied to mitigate for critical big game winter range impacts resulting from the Proposed Action would be applied for the MCAPW-DFT Alternative. The only difference would be that less acreage (109.4 acres versus 141.4 acres) would be acquired as a result of fewer permanent impacts. Anticipated results from implementing this mitigation measure would be the same as those identified for the Proposed Action. Wetland mitigation measures and anticipated results under the MCAPW-DFT Alternative would be the same as discussed under the Proposed Action.

3.5.6.4.5 Unavoidable Adverse Impacts. No unavoidable adverse impacts would be associated with the MCAPW-DFT Alternative if mitigation is implemented and fully successful.

3.5.6.5 MCAP Alternative

The following sections describe the construction- and operation-related impacts resulting from the MCAP Alternative. These impacts are summarized in Section 3.5.6.10.

3.5.6.5.1 Construction Impacts. The following sections identify and discuss the significance of construction-related impacts. The areas of pre-construction wildlife habitat that would be disturbed, permanently lost, or converted to another habitat type as a result of construction and operation activities are summarized in Table 3.5-9. For the purpose of this analysis, the "area of total disturbance" is defined as the area that would be disturbed (temporarily and permanently) by construction and operation activities. The "area of permanent habitat loss" is defined as those areas that would permanently lose habitat as a result of construction activities, inundation, or the siting of permanent facilities. The areas identified as permanently converted to another habitat type would be replanted and would convert into another vegetation/habitat community type. Wetlands that would convert to a non-vegetated wetland community type (e.g., riparian shrub to creek bed/riverine) are also included in this category.

3.5.6.5.1.1 Vegetation/Wildlife Habitat

Monks Hollow Dam and Reservoir. Construction-related impacts of the Monks Hollow Dam and Reservoir were taken from descriptions of the Diamond Fork System Recommended Plan in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990) and *Diamond Fork Power System FEIS* (USBR 1984). The Recommended Plan includes several features in addition to the proposed Monks Hollow Dam and Reservoir, including Syar Tunnel, Sixth Water Aqueduct, and Diamond Fork Pipeline. Impact descriptions provided in the aforementioned documents do not quantify impacts by these specific features; therefore, the discussion in this section includes some impacts that have occurred from the earlier construction of existing Diamond Fork System facilities. However, impacts to habitats known to be outside of the reservoir inundation area (i.e., agriculture and aspen/conifer) have been excluded.

Permanent loss of wildlife habitat within the Diamond Fork drainage would total 388.5 acres (see Table 3.5-9), including 0.5 acre of wetland habitat. Most of the loss would be attributable to construction of the dam and inundation of Monks Hollow Reservoir and construction of appurtenant structures (USBR 1990). Most of the temporary losses have resulted from features previously constructed under the Diamond Fork System Recommended Plan.

Main Conveyance Aqueduct and Associated Features. Impacts that would result from construction of the Main Conveyance Aqueduct and associated facilities, as well as the West Mona and Salt Creek facilities, are included in Table 3.5-9. A total of 1,103.0 acres of wildlife habitat would be disturbed during construction. Of this amount, 105.9 acres would be permanently lost as a result of permanent facilities and the removal of 13 miles of the High Line Canal, and 997.1 acres would be revegetated.

A total of 175.4 acres of pre-construction wildlife habitat would be revegetated, but permanently converted to another habitat type. Specifically, the restoration objectives identified in Table 3.5-9 would result in the conversion of oak woodland and pinyon/juniper communities. Oak woodland and pinyon/juniper communities would be converted to a grass/shrub community since no trees would be allowed within the permanent right-of-way because of pipeline maintenance requirements. Consequently, this would result in a permanent loss of 166.9 acres of oak woodland and 8.5 acres of pinyon/juniper habitat.

Table 3.5-9
Area of Wildlife Habitat Disturbance Resulting from the MCAP Alternative

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss[a] (acres)	Wildlife Habitat Restoration Objectives		Area of Permanent Habitat Type Conversion (acres)
			Temporary (1-3 years)	Long-Term (3+ years)	
Monks Hollow Dam and Reservoir[b]					
Sagebrush/Grass	74.0	60.0	---	---	0.0
Reseeded	82.0	73.0	---	---	0.0
Mountain Brush	206.0	147.0	---	---	0.0
Pinyon/Juniper	112.0	108.0	---	---	0.0
Wetlands	14.0	0.5	---	---	45.0[c]
Subtotal	**488.0**	**388.5**			**45.0**
Main Conveyance Aqueduct and Associated Features[d]					
Oak Woodland	173.9	7.0	Grass/forb	Grass/shrub	166.9
Sagebrush/Grass	589.4	49.1	Grass/forb	Sagebrush/grass	0.0
Bitterbrush/Grass	9.0	2.0	Grass/forb	Bitterbrush	0.0
Pinyon/Juniper	8.5	0.0	Grass/forb	Grass/shrub	8.5
Wetlands[e]	2.5	1.2	Grass/forb	Grass/forb/shrub	0.9[f]
Agricultural Land	222.0	33.6[g]	Cultivation	Cultivation	0.0
Previously Disturbed	97.7	13.0	Grass/forb	Grass/shrub	0.0
Subtotal	**1,103.0**	**105.9**			**176.3**
Totals	**1,591.0**	**494.4**			**221.3**

[a]Includes 13 acres of open water habitat within the primarily concrete-lined High Line Canal that would be lost from distance marker 39,000 to 94,000. For the purpose of this analysis, this area was classified as previously disturbed habitat and not as wetland habitat.
[b]See the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) for more detailed information.
[c]Operation of Monks Hollow Dam and Reservoir would result in the permanent inundation of 45 acres of wetland habitat.
[d]These acreages include temporary and permanent disturbances for construction of the Main Conveyance Aqueduct, recreation trail, turnouts, regulating ponds, equalization reservoirs, Main Conveyance Reservoir, and West Mona facilities.
[e]See Table 3.4-7 in Section 3.4, Wetland Resources, for a breakdown of specific impacted wetland community types.
[f]This permanent conversion would be a result of operation of the Main Conveyance Aqueduct.
[g]This area represents orchards that would be lost resulting from the placement of the Main Conveyance Aqueduct.

Temporary and long-term disturbance to 997.1 acres of wildlife habitat (1,103.0 minus 105.9) would not be considered a significant impact because the disturbance would occur incrementally over a 10-year period, the majority of habitat would be restored to pre-construction conditions, and the affected habitats are abundant in the impact area of influence. Long-term impacts are limited to sagebrush/grass and bitterbrush/grass habitats, as revegetation to pre-construction conditions (i.e., similar to adjacent habitats in terms of shrub density, cover height, and composition) would likely take many years.

The permanent loss of 105.9 acres of wildlife habitat would not be a substantial acreage loss when compared to available habitat within the impact area of influence. However, approximately 60 acres out of the 105.9 acres include oak woodland and sagebrush/grass vegetation that is designated as critical big game winter range habitat (see Table 3.5-10). According to the significance criterion, a permanent loss of critical big game winter range

would be a significant impact. See Section 3.5.6.5.1.2 for a discussion of impacts associated with disturbance to critical big game winter range habitat.

Table 3.5-10
Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting from the MCAP Alternative

<table>
<tr><th>Critical Winter Range</th><th>Location by Distance Marker or Feature</th><th>Distance (linear feet)</th><th>Right-of-Way Width (feet)</th><th>Temporary Disturbance (acres)</th><th>Permanent Disturbance (acres)</th></tr>
<tr><td colspan="6">Monks Hollow Dam and Reservoir[a]</td></tr>
<tr><td>Mule Deer Only</td><td>Monks Hollow Dam and Reservoir</td><td>---</td><td>---</td><td>340.0</td><td>713.0</td></tr>
<tr><td colspan="6">Main Conveyance Aqueduct and Associated Facilities</td></tr>
<tr><td rowspan="2">Dual Use</td><td>37,500-45,000</td><td>7,500</td><td>200</td><td rowspan="2">110.5</td><td rowspan="2">6.0</td></tr>
<tr><td>91,000-107,500</td><td>16,500</td><td>200</td></tr>
<tr><td rowspan="4">Mule Deer Only</td><td>45,000-53,000</td><td>8,000</td><td rowspan="3">200</td><td rowspan="4">310.3[b]</td><td rowspan="4">54.0</td></tr>
<tr><td>85,000-91,000</td><td>6,000</td></tr>
<tr><td>118,000-163,000</td><td>45,000</td></tr>
<tr><td>218,000-225,000</td><td>7,000</td><td>120</td></tr>
<tr><td rowspan="3">Elk Only</td><td>300-10,000</td><td>9,700</td><td>90 (average width)</td><td rowspan="3">55.0</td><td rowspan="3">0.0</td></tr>
<tr><td>32,500-37,500</td><td>5,000</td><td>200</td></tr>
<tr><td>107,500-110,000</td><td>2,500</td><td>200</td></tr>
<tr><td>Subtotal</td><td></td><td></td><td></td><td>475.8</td><td>60.0</td></tr>
<tr><td colspan="4">Total Area</td><td>815.8</td><td>773.0</td></tr>
</table>

[a]See *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) for more detailed information.
[b]This includes 20.3 acres of temporary disturbance associated with the four Mona Pipeline spur lines.
Source: Barney 1994, USBR 1990

The permanent loss of 1.2 acres of wetland habitat would not be considered a significant impact to wildlife. However, it is considered significant according to the wetland resources significance criteria (see Section 3.4, Wetland Resources, for more detail).

3.5.6.5.1.2 General Wildlife

Monks Hollow Dam and Reservoir. The FWS Habitat Evaluation Procedure was used to describe Diamond Fork System impacts on terrestrial wildlife species based on habitat acreages that would be lost or gained (USBR 1984 and 1990) as a result of the construction of Monks Hollow Dam and Reservoir and associated facilities. Indicator species included bobcat, golden eagle (*Aquila chrysaetos*), Cooper's hawk (*Accipiter cooperii*), and beaver (*Castor canadensis*). Impacts to bobcat habitat would be approximately 334 acres lost permanently and 610 acres disturbed temporarily. Permanent impacts to Cooper's hawk habitat would be a loss of approximately 98 acres, while 11 acres would be temporarily impacted. Thirty-seven acres of beaver habitat would be permanently impacted and 14 acres would be temporarily impacted.

Temporary and permanent habitat disturbance that would occur within critical big game winter range resulting from construction of Monks Hollow Dam and Reservoir is summarized in Table 3.5-10. Impacts discussed include all features of the Diamond Fork System Recommended Plan in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990); therefore, impacts would be less for Monks Hollow Dam and Reservoir alone. A total of 713 acres of severe (critical) winter range for mule deer would be permanently impacted. Approximately 340 acres of severe mule deer winter range would be temporarily impacted.

Main Conveyance Aqueduct and Associated Facilities. Clearing, grading, and trenching for the Main Conveyance Aqueduct and associated facilities would result in direct mortality to less mobile animals such as certain reptiles, amphibians, and small mammals. Other animals would escape construction areas and displace into surrounding habitats, where available. Disturbed areas that would be revegetated following construction would be recolonized through immigration of animals from adjacent habitats within 1 to 3 years. These impacts to reptiles, amphibians, and small mammals would not be significant because most of the species that would be affected are locally and regionally common; construction would occur incrementally over a 10-year period; relatively few individuals of any species would be affected; and the continued existence of species within southern Utah and eastern Juab Counties would not be substantially disturbed.

Open trenches would create a temporary hazard to reptiles, amphibians, and small mammals and a barrier to their movement. However, several strategies would be used to reduce this impact, including limiting the length of open trench to no more than 600 feet at any time. Trenches would also be backfilled or covered at the end of each day; all trenches would be inspected for trapped animals prior to backfilling.

Specific construction-related impacts to waterbirds, raptors, upland game birds, passerine birds and related species, mammalian predators, and big game are presented below.

Waterbirds. The Main Conveyance Aqueduct and associated facilities would be sited to avoid most wetland communities preferred by waterbirds such as ducks, geese, shorebirds, and wading birds. As shown on Table 3.5-9, a total of 1.2 acres of wetland habitat would be permanently lost as a result of construction. This loss would not substantially disturb waterfowl and is not considered a significant impact.

Raptors. Construction activities could disturb raptors nesting up to 1 mile from the Main Conveyance Aqueduct and distribution system facilities. However, the locations of these facilities would be near existing residential communities, highways, railroads, and other sources of disturbance that deter many raptors from nesting. If active nests were located near SFN System facilities, construction disturbance would increase the potential for nest abandonment, loss of eggs and young, and a resulting short-term decline in recruitment to the population. However, very few nesting pairs would be affected and some pairs could nest again at alternate sites in the area. The potential for short-term declines in productivity would not be a significant impact as most species would recover the following season in the absence of other environmental perturbations. Temporary reductions in the prey base could also occur during construction, but the impact would not be significant as the loss of prey would be short term and restricted to construction sites and would represent a fraction of the prey available to raptors in southern Utah and eastern Juab Counties.

Upland Game Birds. Construction of the MCAP Alternative would result in both permanent and temporary loss of breeding and foraging habitat for the few species of upland game birds present in the impact area of influence. The loss of small amounts of foraging habitat would not be significant since suitable foraging habitat for these species is abundant in the region. Clearing and grading activities could result in the loss of nests, eggs, and young of the few birds that might nest in construction sites. These impacts would not cause a substantial disturbance to upland game birds as few birds would be affected and habitats within the proposed construction areas are of low value to most upland game birds.

Passerine Birds and Related Species. Construction of the MCAP Alternative would result in both permanent and temporary loss of breeding and foraging habitat for passerine birds and related species that occur in the impact area of influence. The loss of foraging habitat would not be significant as suitable foraging habitat for these species is abundant in the region. Disturbance of nesting birds could result from clearing and grading operations and cause the loss of a few nests, eggs, and young. These impacts would not be significant as few birds would be affected, most of the species affected are locally and regionally common, and the continued existence of these species within southern Utah and eastern Juab Counties would not be substantially disturbed.

Mammalian Predators. Most mammalian predators, such as skunks and coyotes, that occur in the impact area of influence have large home ranges and are highly mobile, thus enabling them to avoid construction activities. Potential impacts to these species would not be significant as few individuals would be affected, most species are locally common and widespread, and prey populations would not be substantially disturbed.

Big Game. The temporary and permanent habitat disturbance that would occur within critical big game winter range from construction of the Main Conveyance Aqueduct under the MCAP Alternative is summarized in Table 3.5-10. As shown in the table, temporary disturbance would occur to 110.5 acres of critical winter range used by both mule deer and elk (dual use). In addition, 310.3 acres of critical mule deer winter range and 55 acres of critical elk winter range would be temporarily disturbed. All areas temporarily disturbed would be revegetated following construction, but as discussed previously, areas currently supporting woodland, pinyon/juniper, and wetland would be converted to forb/shrub habitat. It is recognized that revegetation to sagebrush and bitterbrush/grass habitat would result in a long-term impact because of the length of time required for these plant communities to reach mature growth.

The construction schedule for the MCAP Alternative has been designed to avoid construction within critical winter range during the sensitive period of December 1 through April 15. Therefore, direct impacts to big game from construction activities would not occur. The disturbance of 455.5 acres would not occur at one time, but would occur as different pipeline segments and facilities were constructed over a 10-year period. The majority of big game range disturbance would occur when the Payson and Mona Pipelines would be built. This disturbance would occur at the western edge of the designated critical winter range habitat, adjacent to populated areas as well as I-15.

Permanent loss of critical winter range habitat (i.e., oak woodland, sagebrush/grass, bitterbrush grass) would be attributed to the recreation trail, three regulating ponds, the Main Conveyance Reservoir, and an equalization reservoir. The total permanent loss of critical winter range habitat for both mule deer and elk would be 60 acres. Although the majority of the permanent loss of habitat would occur along the western edge of the critical winter range, this loss is nonetheless considered significant since the areas would be removed from use by big game (see Section 3.5.6.5.3 for proposed mitigation).

3.5.6.5.2 Operation and Maintenance Impacts. Operation and maintenance impacts that would result from Monks Hollow Dam and Reservoir were not specifically discussed in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) or the *Diamond Fork Power System FEIS* (USBR 1984). Operation of Monks Hollow Dam and Reservoir would result in the permanent inundation of 45 acres of riparian habitat (inundation of habitat other than wetlands was considered to be construction-related). It is assumed that impacts to wildlife and wildlife habitat would be similar to those expected to result from the operation of the Main Conveyance Aqueduct and its associated facilities. Operation and maintenance impacts of the Main Conveyance Aqueduct and associated facilities under the MCAP Alternative would be the same as those described under the Proposed Action.

3.5.6.5.3 Related Actions (Local Development). Impacts of related actions that would occur as a result of the MCAP Alternative would be the same as those described under the Proposed Action.

3.5.6.5.4 Mitigation. The same measures that would be applied to mitigate for critical big game winter range impacts resulting from the Proposed Action would be applied for the MCAP Alternative; however, these mitigation measures would apply only to the Main Conveyance Aqueduct and its associated facilities as Monks Hollow Dam and Reservoir would be mitigated as part of the Diamond Fork System. The only difference is that less acreage (120 acres versus 141.4 acres) would be acquired. Anticipated results from implementing this mitigation measure would be the same as for the Proposed Action. Wetland mitigation measures and anticipated results would also be the same as the Proposed Action.

3.5.6.5.5 Unavoidable Adverse Impacts. There would be no unavoidable adverse impacts associated with the MCAP Alternative if the mitigation is implemented and fully successful.

3.5.6.6 MCAPW Alternative

3.5.6.6.1 Construction Impacts. Impacts resulting from construction of Monks Hollow Dam and Reservoir under the MCAPW Alternative would be the same as those identified under the MCAP Alternative. Construction-related impacts of the Main Conveyance Aqueduct and its associated facilities would be the same as those identified under the MCAPW-DFT Alternative. Construction-related impacts to wildlife habitat under the MCAPW Alternative are summarized in Table 3.5-11. Impacts to critical big game winter range are summarized in Table 3.5-12.

3.5.6.6.2 Operation and Maintenance Impacts. Operation and maintenance impacts on wildlife and their habitats resulting from the Monks Hollow Dam and Reservoir would be the same as those described for the MCAP Alternative. Impacts resulting from the operation of the Main Conveyance Aqueduct and associated facilities under the MCAPW Alternative would be the same as those described for the MCAPW-DFT Alternative.

3.5.6.6.3 Related Actions (Local Development). Impacts of related actions under the MCAPW Alternative would be the same as those described under the MCAPW-DFT Alternative.

3.5.6.6.4 Mitigation. The same measures that would be applied to mitigate for critical big game winter range impacts resulting from the Proposed Action would be applied for the MCAP Alternative; however, these mitigation measures would apply only to the Main Conveyance Aqueduct and its associated facilities as Monks Hollow Dam and Reservoir would be mitigated as part of the Diamond Fork System. The only difference is that less acreage (120 acres versus 141.4 acres) would be acquired. Anticipated results from implementing this mitigation measure would be the same as for the Proposed Action. Wetland mitigation measures and anticipated results would also be the same as the Proposed Action.

3.5.6.6.5 Unavoidable Adverse Impacts. There would be no unavoidable impacts associated with the MCAPW Alternative if the mitigation is implemented and fully successful.

3.5.6.7 MCATC Alternative

The following sections describe the construction- and operation-related impacts resulting from the MCATC Alternative. These impacts are summarized in Section 3.5.6.10.

3.5.6.7.1 Construction Impacts. The following sections identify and discuss the significance of construction-related impacts. Impacts resulting from construction of the Monks Hollow Dam and Reservoir under the MCATC Alternative would be the same as those identified under the MCAP Alternative. Construction-related impacts of the Main Conveyance Aqueduct and associated facilities under the MCATC Alternative would be the same as those described for the MCAP Alternative, except as discussed below.

Table 3.5-11
Area of Wildlife Habitat Disturbance Resulting from the MCAPW Alternative

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss[a] (acres)	Wildlife Habitat Restoration Objectives		Area of Permanent Habitat Type Conversion (acres)
			Temporary (1-3 years)	Long-Term (3+ years)	
Monks Hollow Dam and Reservoir[b]					
Sagebrush/Grass	74.0	60.0	---	---	0.0
Reseeded	82.0	73.0	---	---	0.0
Mountain Brush	206.0	147.0	---	---	0.0
Pinyon/Juniper	112.0	108.0	---	---	0.0
Wetlands	14.0	0.5	---	---	45.0[c]
Subtotal	**488.0**	**388.5**			**45.0**
Main Conveyance Aqueduct and Associated Facilities					
Oak Woodland	173.9	9.5	Grass/forb	Grass/shrub	164.4
Sagebrush/Grass	585.3	41.4	Grass/forb	Sagebrush/grass	0.0
Bitterbrush/Grass	10.8	2.0	Grass/forb	Bitterbrush	0.0
Pinyon/Juniper	8.5	0.0	Grass/forb	Grass/shrub	8.5
Wetlands[d]	2.5	1.0	Grass/forb	Grass/forb/shrub	4.1[e]
Agricultural Land	222.0	33.6[f]	Cultivation	Cultivation	0.0
Previously Disturbed	97.7	0.0	Grass/forb	Grass/shrub	0.0
Subtotal	**1,100.7**	**87.5**			**177.0**
Totals	**1,588.7**	**476.0**			**222.0**

[a]These acreages include temporary and permanent disturbances for construction of the Main Conveyance Aqueduct, turnouts, regulating ponds, equalization reservoirs, Main Conveyance Reservoir, and West Mona facilities.
[b]See *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) for more detailed information.
[c]Operation of Monks Hollow Dam and Reservoir would result in the permanent inundation of 45 acres of wetland habitat.
[d]See Tables 3.4-10 and 3.4-12 in Section 3.4, Wetland Resources, for a breakdown of specific impacted wetland community types.
[e]This permanent conversion would be a result of operation of the Main Conveyance Aqueduct.
[f]This area represents orchards that would be lost resulting from the placement of the Main Conveyance Aqueduct.

Table 3.5-12
Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting from the MCAPW Alternative

Critical Winter Range	Location by Distance Marker or Feature	Distance (linear feet)	Right-of-Way Width (feet)	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Monks Hollow Dam and Reservoir[a]					
Mule Deer Only	Monks Hollow Dam and Reservoir	---	---	340.0	713.0
Main Conveyance Aqueduct and Associated Facilities					
Dual Use	37,500-45,000	7,500	200	110.5	0.0
	91,000-107,500	16,500	200		
Mule Deer Only	45,000-53,000	8,000	200	310.3[b]	44.0[c]
	85,000-91,000	6,000			
	118,000-163,000	45,000			
	218,000-225,000	7,000	120		
Elk Only	300-10,000	9,700	90 (average width)	55.0	0.0
	32,500-37,500	5,000	200		
	107,500-110,000	2,500	200		
Subtotal				**475.8**	**44.0**
Total Area				**815.8**	**757.0**

[a]See *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) for more detailed information
[b]This includes 20.3 acres of temporary disturbance associated with the four Mona Pipeline spur lines.
[c]These ±44 acres are comprised of 7.8 acres associated with regulating ponds SU7, EJ3, and EJ4; 1 acre associated with one equalization reservoir; and 35 acres associated with the Main Conveyance Reservoir.
Source: Barney 1994

3.5.6.7.1.1 Vegetation/Wildlife Habitat. Because the Main Conveyance Aqueduct alignment in southern Utah County differs from the Proposed Action alignment, the amount of temporary disturbance to wildlife habitat associated with the MCATC Alternative would be 927.1 acres, as shown in Table 3.5-13. Of this amount, 51.9 acres would be permanently lost as a result of the construction of permanent facilities, leaving 875.2 acres to be revegetated. A total of 121.5 acres of wildlife habitat would be converted to another habitat type (grass/forb/shrub) including 113 acres of oak woodland and 8.5 acres of pinyon/juniper.

As identified previously under the MCAP Alternative, this temporary disturbance would not be a significant impact because the habitat would be restored to pre-construction conditions, the disturbance would occur over a 10-year period, and other suitable habitat would be available.

Table 3.5-13
Area of Wildlife Habitat Disturbance Resulting from the MCATC and MCAT Alternatives

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss[a] (acres)	Wildlife Habitat Restoration Objectives		Area of Permanent Habitat Type Conversion (acres)
			Temporary (1-3 years)	Long-Term (3+ years)	
Monks Hollow Dam and Reservoir[b]					
Sagebrush/Grass	74.0	60.0	---	---	0.0
Reseeded	82.0	73.0	---	---	0.0
Mountain Brush	206.0	147.0	---	---	0.0
Pinyon/Juniper	112.0	108.0	---	---	0.0
Wetlands	14.0	0.5	---	---	45.0[c]
Subtotal	**488.0**	**388.5**			**45.0**
Main Conveyance Aqueduct and Associated Facilities					
Oak Woodland	120.0	7.2	Grass/forb	Grass/shrub	113.0
Sagebrush/Grass	476.2	42.9	Grass/forb	Sagebrush/grass	0.0
Bitterbrush/Grass	0.0	0.0	Grass/forb	Bitterbrush	0.0
Pinyon/Juniper	8.5	0.0	Grass/forb	Grass/shrub	8.5
Wetlands	2.2	1.7	Grass/forb	Grass/forb/shrub	0.9[d,e]
Agricultural Land	243.0	0.1	Cultivation	Cultivation	0.0
Previously Disturbed	77.2	0.0	Grass/forb	Grass/shrub	0.0
Subtotal	**927.1**	**51.9**			**122.4[d]**
Totals	**1,415.1**	**440.4**			**167.4[d]**

[a]These acreages include temporary and permanent disturbances for construction of the Main Conveyance Aqueduct, turnouts, regulating ponds, equalization reservoirs, and Main Conveyance Reservoir. This acreage does not include subsurface disturbance caused by the tunnels.
[b]See *Diamond Fork Final Supplement to the FEIS* (USBR 1990) for more detailed information.
[c]Operation of Monks Hollow Dam and Reservoir would result in the permanent inundation of 45 acres of wetland habitat.
[d]Under the MCAT Alternative, total disturbance because of construction would be the same as under the MCATC Alternative, but 4.1 acres of wetland habitat would convert to another habitat type because of increased flows in the Spanish Fork River (operational impact) (see Table 3.4-10 in Section 3.4, Wetland Resources).
[e]This permanent conversion would be a result of operation of the Main Conveyance Aqueduct.

When compared to the total available habitat within the impact area of influence, the permanent loss of 51.9 acres of wildlife habitat would not be significant; however, the majority of the habitat loss (oak woodland and sagebrush/grass) would occur in areas designated as critical big game winter range habitat. According to the significance criteria, the loss of habitat within critical big game winter range would be a significant impact. The permanent loss of 1.7 acres of wetland habitat would not be a significant impact to wildlife because it would not create a substantial disturbance to wildlife (see Table 3.4-11). However, according to the wetlands significance criteria, it is considered significant and would be mitigated.

3.5.6.7.1.2 General Wildlife. Construction of the MCATC Alternative would impact wildlife populations in essentially the same manner as described for the MCAP Alternative. Minor exceptions include 1) a reduction in

total habitat loss resulting from a more direct alignment and tunnels through Loafer, Tithing, and Dry Mountains; 2) a corresponding reduction in the duration and extent of surface construction activity that would reduce direct disturbance to wildlife; 3) potential for use of blasting during tunnel construction that could adversely affect wildlife in the vicinity of the tunnel portals; and 4) deposition of tunnel spoil on about 15 acres of native brushland habitat. The impacts are not considered significant because they would not affect a substantial portion of any species habitat within the region and would not likely cause a substantial disturbance to wildlife populations within the impact area of influence.

3.5.6.7.1.3 Big Game. The general effects of construction within critical big game winter range under the MCATC Alternative would be similar to those described under the MCAP Alternative. However, the potential for disturbance in the bench area of southern Utah County would be less under the MCATC Alternative because of tunneling through Loafer, Tithing, and Dry Mountains. The temporary and permanent critical big game winter range habitat disturbance that would result from MCATC Alternative construction activities is summarized in Table 3.5-14. As shown in the table, a total of 154 acres of dual use critical winter range would be disturbed. An additional 297.3 acres of critical mule deer winter range and an additional 20 acres of critical winter range elk habitat would be disturbed. As stated previously, it is acknowledged that disturbance to winter range habitat would result in a long-term impact since sagebrush and bitterbrush grass communities would take well over 3 years to become re-established to pre-construction conditions.

Table 3.5-14
Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting from the MCATC and MCAT Alternatives

Critical Winter Range	Location by Distance Marker	Distance (linear feet)	Right-of-Way Width (feet)	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Monks Hollow Dam and Reservoir[a]					
Mule Deer Only	Monks Hollow Dam and Reservoir	---	---	340.0	713.0
Main Conveyance Aqueduct and Associated Facilities					
Dual Use	74,000-107,500	33,500	200	154.0	4.5
Mule Deer Only	36,700-44,000	4,300	200	297.3[b]	40.3
	69,900-74,000	4,100			
	118,000-163,000	45,000			
	218,000-225,000	7,000			
Elk Only	300-10,000	9,700	90 (average width)	20.0	0.0
Subtotal				**471.3**	**44.8**[c]
Total Area				**811.3**	**757.8**

[a]See *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) for more detailed information.
[b]This includes 20.3 acres of temporary disturbance associated with the four Mona Pipeline spur lines.
[c]These 45 acres are comprised of 4.5 acres associated with regulating pond SU7; 35 acres associated with the Main Conveyance Reservoir; and 2 acres associated with the equalization reservoirs.
Source: Barney 1994

Permanent loss of 44.8 acres of critical winter range habitat would result from the construction of permanent SFN System facilities. Although the majority of permanent habitat loss would occur along the western perimeter of the critical range habitat, the loss would, nonetheless, be a significant impact.

3.5.6.7.2 Operation and Maintenance Impacts. Operation and maintenance impacts on wildlife and their habitat that would result from the MCATC Alternative would be similar to those described for the MCAP Alternative. As with the MCAP Alternative, this impact would not be significant.

The recreation trail would not be built under the MCATC Alternative; therefore, the potential impacts identified under the MCAP Alternative would not occur.

3.5.6.7.3 Related Actions (Local Development). The following sections describe the local development construction- and operation-related impacts that would occur as a result of the MCATC Alternative. On-farm system impacts would be the same as described for the Proposed Action.

3.5.6.7.3.1 Local Distribution Systems. The amount of wildlife habitat that would be disturbed as a result of constructing and operating M&I and irrigation distribution systems related to the MCATC Alternative is summarized in Table 3.5-15. A total of 914.8 acres would be temporarily disturbed. Of this amount, 18.0 acres of wetlands would be lost, including 6.4 acres associated with the M&I systems and 11.6 acres associated with the irrigation distribution systems. The remainder of disturbed habitat consists of agricultural and previously disturbed lands that would either be returned to agricultural production, revegetated, or covered with asphalt and/or concrete. Even though a greater amount of habitat would be disturbed under this alternative, impacts to wildlife resources would not be significant for the same reasons identified for the Proposed Action.

Table 3.5-15
Area of Wildlife Habitat Disturbance Associated with Related Actions Resulting from the MCATC Alternative

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss (acres)
M&I Water Distribution Systems		
Asphalt/concrete	257.6	0.0
Wetlands[a]	6.4	6.4
Previously disturbed	58.0	0.0
Subtotal	**322.0**	**6.4**
Irrigation Distribution Systems		
Existing canal	173.4	120.1
Agricultural lands	563.1	95.8
Sagebrush/grass	54.8	13.2
Oak woodland	0.2	0.1
Wetlands[b]	11.6	11.6[c]
Developed lands	114.2	37.2
Subtotal	**917.3**	**278.0**
Total	**1,239.3**	**284.4**

[a]See Table 3.4-12 in Section 3.4, Wetland Resources, for a breakdown of acreage figures.
[b]Includes 0.9 acre of riparian habitat that will be removed as a result of the EJWEP, which will be constructed prior to the Main Conveyance Aqueduct.
[c]Includes 2.5 acres of wetland impact resulting from operation of Salt Creek facilities.

3.5.6.7.4 Mitigation. The same measures that would be applied to mitigate for critical big game winter range impacts resulting from the Proposed Action would be applied for the MCATC Alternative; however, these mitigation measures would apply only to the Main Conveyance Aqueduct and its associated facilities as Monks Hollow Dam and Reservoir would be mitigated as part of the Diamond Fork System. The only difference is that less acreage (89.6 acres versus 141.4 acres) would be acquired. Anticipated results from implementing this mitigation measure would be the same as for the Proposed Action. Wetland mitigation measures and anticipated results would also be the same as the Proposed Action.

3.5.6.7.5 Unavoidable Adverse Impacts. There would be no unavoidable adverse impacts associated with the MCATC Alternative if the mitigation is implemented and fully successful.

3.5.6.8 MCAT Alternative

The following sections describe the construction- and operation-related impacts that would result from the MCAT Alternative. These impacts are summarized in Section 3.5.6.10.

3.5.6.8.1 Construction and Operation Impacts. Impacts to wildlife habitat under the MCAT Alternative would be the same as those identified for the MCATC Alternative, except for operation impacts to wetland communities. Operation of Monks Hollow Reservoir would result in 45 acres of converted wetland habitat and 4.1 acres would be converted to another habitat type as a result of operation of the SFN System (see Table 3.5-13). Impacts to critical big game winter habitat would be the same as described for the MCATC Alternative.

3.5.6.8.2 Related Actions (Local Development). The amount of wildlife habitat that would be disturbed from construction and operation of M&I and irrigation distribution systems resulting from the MCAT Alternative is summarized in Table 3.5-16. A total of 445.6 acres would be temporarily disturbed. Because the improvement to existing irrigation distribution system facilities would not be as extensive (since SWUA water would not be delivered through the SFN System), the area of disturbance compared to the Proposed Action and the MCATC Alternative would be substantially decreased. The same amount of wetland habitat associated with M&I systems would be permanently lost (6.4 acres) and 4.4 acres of wetland habitat associated with the irrigation distribution system would be lost. Wildlife impacts attributed to local development under this alternative would be similar to those identified for the MCAP and MCATC Alternatives. Neither the temporary nor permanent disturbances would be considered significant impacts since neither would cause substantial disturbances to wildlife within the impact area of influence.

3.5.6.8.3 Mitigation. Because impacts to critical big game winter range and wetlands would be similar to those described for the MCATC Alternative, the mitigation would be the same described for as the MCATC Alternative.

3.5.6.8.4 Unavoidable Adverse Impacts. There would be no unavoidable impacts associated with the MCAT Alternative if the mitigation is implemented and fully successful.

3.5.6.9 No Action Alternative

Information on construction-related impacts of the No Action Alternative was taken from descriptions of Alternative C in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990), *Diamond Fork Power System FEIS* (USBR 1984), and *Terrestrial Wildlife and Vegetation Impact Analysis and Mitigation Recommendations for Alternatives A, B, and C Diamond Fork System* (Christensen et al. 1989). Under the No Action Alternative, the SFN System would not be constructed and the Diamond Fork System would be completed by constructing Three Forks Dam and Reservoir and the Diamond Fork Pipeline Extension.

Table 3.5-16
Area of Wildlife Habitat Disturbance Associated with Related Actions Resulting from the MCAT Alternative

Pre-Construction Wildlife Habitat	Area of Total Disturbance (acres)	Area of Permanent Habitat Loss (acres)
M&I Water Distribution Systems		
Asphalt/concrete	257.6	0.0
Wetlands	6.4	6.4[a]
Previously disturbed	58.0	0.0
Subtotal	**322.0**	**6.4**
Irrigation Distribution Systems		
Existing canal	0.0	0.0
Agricultural lands	430.0	53.8
Sagebrush/grass	19.0	8.5
Oak woodland	0.2	0.1
Wetlands[b]	4.6	4.6[c]
Developed lands	46.4	17.0
Subtotal	**500.2**	**84.0**
Total	**822.2**	**90.4**

[a]This habitat would convert to upland habitat.
[b]Includes 0.9 acre of riparian habitat that will be removed as a result of the EJWEP, which will be constructed prior to the Main Conveyance Aqueduct.
[c]Includes 2.5 ares of wetland impact resulting from operation of Salt Creek facilities.

3.5.6.9.1 Construction and Operation Impacts. The following sections identify and discuss the significance of construction- and operation-related impacts. No SFN System facilities would be constructed under the No Action Alternative; therefore, no SFN System construction- and operation-related impacts would occur under this alternative. Diamond Fork System features included in the No Action Alternative impact analysis are Three Forks Dam and Reservoir, the Diamond Fork Pipeline Extension, roads, recreation sites, and borrow areas. All areas excavated or denuded of vegetation would be rehabilitated in consultation with affected landowners (USBR 1990). Additionally, M&I systems would be developed by local entities to deliver 11,200 acre-feet of Bonneville Unit M&I water.

3.5.6.9.1.1 Vegetation/Wildlife Habitat. The No Action Alternative would result in the temporary loss of 80.0 acres of vegetation/wildlife habitat (USBR 1990), as shown in Table 3.5-17. The greatest impact would occur in mountain brush habitat as a result of excavation of borrow areas (Christensen et al. 1989). Riparian habitats would be significantly, but temporarily impacted by construction of the Diamond Fork Pipeline Extension (Christensen et al. 1989).

As shown in Table 3.5-17, permanent loss of vegetation/wildlife habitats as a result of the No Action Alternative would total 69.4 acres (Christensen et al. 1989; USBR 1990). Impacts would occur primarily in mountain brush habitat and smaller amounts of reseeded lands, pinyon-juniper, and riparian vegetation as a result of access road construction (Christensen et al. 1989). As a result of locally developed M&I systems, 6.4 acres of wetlands would be converted to upland habitat.

Table 3.5-17
Wildlife Habitat Disturbance Resulting from the Construction and Operation of the No Action Alternative

Vegetation Type	Area of Habitat Disturbance (acres)	
	Temporary[a]	Permanent[b]
Sagebrush	6.8	+1.5
Reseeded	3.2	10.0
Mountain Brush	47.4	24.0
Pinyon/Juniper	0.4	4.5
Agriculture	13.2	0.0
Wetland	9.0	32.4
Aspen/Conifer	0.0	0.0
Total	**80.0**	**69.4**

[a]Temporary losses include those vegetated areas where disturbance would occur during construction, after which the land surface would be rehabilitated and revegetated to the extent possible. It is assumed that, with proper rehabilitation, these areas would regain 75 percent or more of their wildlife habitat value.
[b]Permanent losses include those vegetated areas where permanent surface features would be placed.

Construction of the Diamond Fork Pipeline Extension from the existing Diamond Fork Pipeline to Three Forks Dam would require temporarily disturbing 9 acres of wetland habitat along Diamond Fork Creek. The disturbed areas would be restored following construction. Construction of Three Forks Dam would result in 0.5 acre of permanent loss of wetlands. Operation of Three Forks Dam and Reservoir would result in the conversion of 23 acres of riparian habitat to aquatic bed/open water; however, no significant impacts to wildlife are expected. As a result of the operation of Three Forks Dam, flows in upper Spanish Fork River would increase, resulting in impacts to wetland habitat (2.5 acres, see Table 3.4-14 in Section 3.4, Wetland Resources). Because 2.5 acres would not represent a large area of wildlife habitat within the impact area of influence, this impact would not cause a substantial disturbance to wildlife.

3.5.6.9.1.2 General Wildlife. The FWS Habitat Evaluation Procedure was used to describe Diamond Fork System impacts and develop mitigation options for terrestrial wildlife species based on habitat acres lost or gained (USBR 1984 and 1990). Five indicator species were selected for this analysis: mule deer, bobcat, golden eagle, Cooper's hawk, and beaver. Golden eagle impacts are discussed in Section 3.7, Special-Status Species. The Habitat Evaluation Procedure was not used to determine project impacts for the SFN System DEIS; therefore, impacts of the No Action Alternative are discussed in terms of acres of habitat, not average annual habitat units (AAHU). Impacts to the indicator species are summarized in Table 3.5-18. No Action Alternative impacts on wildlife resulting from construction of the Diamond Fork System may be either temporary or permanent.

The *Diamond Fork System FEIS* (USBR 1984) defines temporary impacts as those habitat losses caused by the removal of vegetation associated with the construction of project features such as buried pipelines and the use of borrow areas. In these types of activities, vegetation would be removed during construction but would be restored afterwards. Another temporary impact is one in which there would be a 50 percent loss of available habitat value for a species within 0.25 mile of a concentrated construction activity, primarily involving dam and reservoir sites. This impact would end when the construction activity is finished (USBR 1984).

Table 3.5-18
Impacts on Wildlife Habitat Caused by the No Action Alternative

Species	Habitat Lost (acres)	
	Temporary	Permanent
Mule deer range[a]		
Nonwinter	47.0	643.0
Normal winter	22.4	714.0
Severe winter	0.0	548.0
Bobcat	82.6	48.0
Cooper's hawk	8.4	63.0
Beaver[b]	11.2	63.0

[a]These figures include loss of habitat value and use by mule deer caused by construction disturbance and use of primary access roads.
[b]There would be a net gain in usable habitat for beaver because high irrigation flows in upper Sixth Water Creek would be eliminated.

Permanent impacts are defined as the removal of vegetative habitat through the construction of new access roads and inundation of vegetative cover by reservoirs (USBR 1984). A permanent impact would also occur to a specific corridor on either side of a new road where there would be a long-term disturbance factor to mule deer caused by increased public use and vehicle traffic, increased vehicle-deer collisions, and increased hunting pressure. This would amount to a loss of 50 percent of the habitat value within 0.25 mile of each side of the road (USBR 1984).

Raptors. Approximately 8.4 acres of Cooper's hawk habitat would be temporarily lost, primarily as the result of disturbance to riparian habitat during construction of the Diamond Fork Pipeline Extension. However, permanent impacts would be greater (63 acres) and caused primarily by loss of riparian habitat as a result of enlargement of recreation sites (Christensen et al. 1989).

Beavers. Under the No Action Alternative, approximately 63.0 acres of beaver habitat would be permanently lost. Approximately 11.2 acres of beaver habitat would be temporarily lost as the result of disturbances to the riparian zone associated with construction of the Diamond Fork Pipeline Extension.

Mammalian Predators. Habitat impacts to bobcats would be 82.6 acres of temporary loss and 48.0 acres of permanent loss. Impacts would occur primarily as a result of access roads, recreation sites, and construction of pipelines and aqueducts (Christensen et al. 1989).

Big Game. Permanent impacts on mule deer would be a loss of approximately 1,905 acres of habitat, 93 percent of which would result from the construction and use of access roads (Christensen et al. 1989; USBR 1990). Temporary habitat loss would be approximately 69.4 acres. Thirty-four percent of the impacts would occur on nonwinter ranges and 66 percent on winter ranges (37 percent normal winter and 29 percent severe winter range) (Christensen et al. 1989).

3.5.6.9.2 Mitigation. Most of the mitigation for the Diamond Fork System has been completed by the USBR. For additional information, refer to USBR 1990 and Christensen et al. 1989.

3.5.6.9.3 Unavoidable Adverse Impacts. There are no unavoidable impacts identified for the No Action Alternative.

3.5.6.10 Summary of Impacts

Table 3.5-19 presents a summary of impacts for the Proposed Action and the MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives. Mitigation measures for features discussed in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990) (i.e., Three Forks Dam and Reservoir and Monks Hollow Dam and Reservoir) are not included.

The only significant impact under the Proposed Action and various alternatives for which no mitigation is proposed would be associated with impacts to on-farm wildlife habitat. No mitigation is proposed in this case because even though the disturbance to the wildlife habitat is considered significant according to the significance criteria, this impact would not result in a substantial disturbance to wildlife species in the impact area of influence. The total impact to wildlife, including temporary loss of cover and forage, in the impact area of influence over the 10-year construction period and the following operation period would not result in a substantial disturbance to sub-populations. Small population decreases may occur as a result of construction activities, but it is fully expected that area wildlife would recolonize impact areas within 3 years of construction (see more detailed discussion in Section 3.5.6.3.1.2).

Table 3.5-19
Summary of Impacts for Wildlife Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
"Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct and Associated Facilities				
Wildlife Habitat	1,231.0 acres temporary disturbance	Not significant	None	Not significant
	176.5 acres habitat conversion	Not significant	None	Not significant
	139.4 acres permanent habitat loss	Significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
General Wildlife	Temporary habitat disturbance, displacement, reduction in available prey base, loss of cover	Not significant	None	Not significant
	Standard maintenance activities may cause temporary disturbances.	Not significant	None	NA
	Elimination of drowning hazard	Not significant	None	NA
	Potential increase in temporary disturbance to wildlife associated with the recreation trail	Not significant	No motorized vehicle use allowed	Not significant

Table 3.5-19
Summary of Impacts for Wildlife Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Big Game	506.4 acres temporary critical big game habitat loss	Not significant	None	Not significant
	70.7 acres permanent loss critical big game winter range	Significant	Acquire 141.4 acres of critical winter range through the Utah Division of Wildlife Resources Winter Range Acquisition Project	Not significant
	Temporary disturbance to migration corridor	Significant	No construction from December 1 to April 15. Work with Utah Division of Wildlife Resources to avoid impacts during fall migration.	Not significant
Related Actions				
Distribution Systems				
Wildlife Habitat	791.5 acres temporary disturbance	Not significant	None	Not significant
	26.8 acres habitat conversion	Not significant	15.3 acres of wetland conversion will be mitigated within the impact area of influence (see Section 3.4 for discussion).	Not significant
On-Farm Systems				
Wildlife Habitat	Change in crop type and irrigation practices in Areas 3b and 4b	Significant	None	Significant
General Wildlife	Loss of nesting cover and corridors for movement	Not significant	None	NA
Big Game	Crop depredation could increase, leading to potential mortality	Not significant	None	NA
MCAPW-DFT Alternative				
"Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct and Associated Facilities				
Wildlife Habitat	1,228.7 acres temporary disturbance	Not significant	None	Not significant
	177.2 acres habitat conversion	Not significant	None	Not significant
	121.2 acres permanent habitat loss	Significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
General Wildlife–Same as Proposed Action, except no impacts associated with the recreation trail would occur as the recreation trail would not be build under the alternative.				

Table 3.5-19
Summary of Impacts for Wildlife Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Big Game	506.4 acres temporary critical big game habitat loss	Not significant	None	Not significant
	54.7 acres permanent loss critical big game winter range	Significant	Acquire 109.4 acres of critical winter range habitat through the Utah Division of Wildlife Resource's Winter Range Acquisition Project	Not significant
	Temporary disturbance to migration corridor	Significant	No construction from December 1 to April 15. Work with Utah Division of Wildlife Resources to avoid impacts during fall migration.	Not significant
Related Actions				
Distribution Systems				
Wildlife Habitat	940.5 acres temporary disturbance	Not significant	None	Not significant
	40.0 acres habitat conversion	Not significant	4.4 acres of wetland impacts will be mitigated within the impact area of influence (see Section 3.4 for discussion).	Not significant
On-Farm Systems–Same as Proposed Action				
MCAP Alternative				
Monks Hollow Dam and Reservoir and Main Conveyance Aqueduct and Associated Facilities				
Wildlife Habitat	1,591.0 acres temporary disturbance	Not significant	None	Not significant
	221.3 acres habitat conversion	Not significant	None	Not significant
	494.4 acres permanent habitat loss	Significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
General Wildlife–Same as Proposed Action				
Big Game	815.8 acres temporary critical big game habitat loss	Not significant	None	Not significant
	773 acres permanent loss of critical big game winter range	Significant	Acquire 120 acres of critical winter range habitat through the Utah Division of Wildlife Resource's Winter Range Acquisition Project	Not significant
Related Actions–Same as Proposed Action				

Table 3.5-19
Summary of Impacts for Wildlife Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
MCAPW Alternative				
Monks Hollow Dam and Reservoir and Main Conveyance Aqueduct and Associated Facilities				
Wildlife habitat	1,588.7 acres of temporary disturbance	Not significant	None	Not significant
	222.0 acres of habitat conversion	Not significant	None	Not significant
	476.0 acres of permanent loss	Significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
General Wildlife	Similar to Proposed Action, but Main Conveyance Aqueduct would not be built in High Line Canal	Not significant	None	Not significant
Big Game	Temporary loss of 815.8 acres of critical winter range	Not significant	None	Not significant
	757 acres of permanent loss of critical winter range	Not significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
Related Actions–Same as MCAPW-DFT Alternative				
MCATC Alternative				
Monks Hollow Dam and Reservoir and Main Conveyance Aqueduct and Associated Facilities				
Wildlife Habitat	1,415.1 acres temporary disturbance	Not significant	None	Not significant
	167.4 acres habitat conversion	Not significant	None	Not significant
	440.4 acres permanent habitat loss	Significant	Acquire land to be preserved under Utah Division of Wildlife Resources Winter Range Acquisition Project and preserve wetland habitat as discussed in Section 3.4.	Not significant
General Wildlife	Same as Proposed Action, except no impacts associated with the recreation trail would occur as it would not be built under this alternative.			
Big Game	Temporary loss of 811.3 acres of critical big game habitat	Not significant	None	Significant
	757.8 acres permanent loss of critical big game winter range	Significant	Acquire 90 acres of critical winter range habitat through the Utah Division of Wildlife Resource's Winter Range Acquisition Project	Not significant

Table 3.5-19
Summary of Impacts for Wildlife Resources

Page 5 of 5

Resources	Impact	Significance	Mitigation	Significance After Mitigation
Related Actions				
Distribution Systems				
Wildlife Habitat	914.8 acres temporary disturbance	Not significant	None	Not significant
	32.9 acres habitat loss	Significant	11.6 acres of wetland impacts will be mitigated within in the impact area of influence (see Section 2.4 for discussion).	Not significant
On-Farm Systems–Same as Proposed Action				
MCAT Alternative				
Monks Hollow Dam and Reservoir and Main Conveyance Aqueduct and Associated Facilities				
Wildlife Habitat	Same as MCATC Alternative, except 4.1 acres of wetland habitat would be convert to another habitat type as a result of operation	Not significant	The 4.1 acres of wetland impacts will be mitigated within the impact area of influence (see Section 3.4 for discussion).	Not significant
General Wildlife–Same as MCATC Alternative				
Big Game–Same as MCATC Alternative				
Related Actions				
Distribution Systems				
Wildlife Habitat	445.6 acres temporary disturbance	Not significant	None	Not significant
	10.8 acres habitat loss	Not significant	10.8 acres of wetland impacts will be mitigated within the impact area of influence (see Section 3.4 for discussion).	Not significant
On-Farm Systems–Same as Proposed Action				
No Action Alternative				
Wildlife Habitat	82.2 acres temporary disturbance	Mitigation measures identified for the Diamond Fork System have been mostly completed by the USBR. For detailed information, refer to USBR 1990 and Christensen et al. 1989.		
	69.4 acres permanent disturbance*			
Big Game	Temporary loss of 1 acre			
	548 acres critical winter range permanently lost			

*Includes 6.4 acres of riparian shrub/wet meadow conversion to upland habitat as a result of locally developed M&I systems.

3.5.6.11 Cumulative Impacts

Section 1.8 identifies projects to be considered in the cumulative impact analysis. All identified projects, except the Utah Lake Wetlands Preserve, occur within the impact area of influence described in Section 3.5.4. The potential impacts of several of these projects have not been fully described; however, most of these projects are

not expected to impact the same wildlife resources as the Proposed Action and alternatives. All potential impacts of the Proposed Action and alternatives on wildlife resources would be fully mitigated. No significant cumulative impacts on wildlife resources are anticipated.

3.6 Aquatic Resources

3.6.1 Introduction

The information and analysis provided in this section have been summarized from the *Aquatic Resources Technical Report* (CUWCD 1998a). This section addresses potential impacts from the construction and operation of the Proposed Action and each of the alternatives upon the following aquatic resources categories:

- Sport fish and their habitat
- Non-sport fish and their habitat
- Other aquatic resources

Potential impacts to special-status fish (species having federal or State status as threatened, endangered, Candidate 1, or species of special concern) within the impact area of influence are described in Section 3.7, Special-Status Species.

Baseline conditions for aquatic resources in the impact area of influence are the conditions that existed during the 1994-1997 period during which the field studies and literature review were performed. The determination of baseline conditions was accomplished through a combination of direct field observations and sampling, published literature and agency file data on resources in the area, and discussions with State and federal agency personnel with knowledge of the aquatic resources present.

3.6.2 Issues Eliminated from Further Analysis

No issues were eliminated from further analysis.

3.6.3 Issues Addressed in the Impact Analysis

The following issues are addressed in the impact analysis:

- Potential impacts to fish and invertebrates found in streams and waterbodies within the aquatic resources impact area of influence

- Potential impacts of SFN System irrigation return flows (e.g., flows, salinity, temperature, turbidity, and trace elements) on the fish and aquatic invertebrates of West Creek, Burraston Ponds, upper and lower Currant Creek, Mona Reservoir, Spring Creek, Beer Creek, Benjamin Slough, and the lower Spanish Fork River

The potential impacts of the Bonneville Unit operation on the fish and aquatic invertebrates of Utah Lake and the Jordan River are addressed in Chapter 2.

3.6.4 Description of Impact Area of Influence

The impact area of influence for evaluating impacts on aquatic resources consists of waterways located in southern Utah and eastern Juab Counties that could be affected by the construction and operation of the Proposed Action and alternatives, including related irrigation distribution and on-farm systems. (As noted above, Utah Lake and the Jordan River are within the Bonneville Unit impact area of influence and are described in Chapter 2.) The fishery resources within the impact area of influence, including historical fisheries, are confined to the following

perennial, or formerly perennial, bodies of water (see Table 3.6-1 for more detailed reach descriptions for certain streams):

- Sixth Water Creek from the Strawberry Tunnel outlet downstream to Diamond Fork Creek (Three Forks)
- Diamond Fork Creek from the Tanner Ridge Tunnel outlet downstream to Three Forks
- Diamond Fork Creek from Three Forks downstream to its confluence with the Spanish Fork River
- Upper Spanish Fork River from the mouth of Diamond Fork Creek downstream to the existing Strawberry Diversion Dam
- Lower Spanish Fork River from the Strawberry Diversion Dam downstream to Utah Lake
- Summit Creek and Peteetneet Creek
- Salt Creek downstream of the existing water diversion structure near the mouth of Salt Creek Canyon to the west side of the city of Nephi
- Burraston Ponds, West Creek, and upper Currant Creek
- Mona Reservoir and lower Currant Creek
- Beer Creek and its tributary, Spring Creek, and the lower end of Beer Creek known as Benjamin Slough

3.6.5 Affected Environment

The affected environment for aquatic resources includes algae, aquatic plants and other lower trophic-level aquatic biota, as well as native and sport fish, water quality, and instream flow. For purposes of this analysis, the description of the affected environment focuses on sport fish because they are indicative of the overall health of an aquatic system and because they have recreational and economic value. Where no significant sport fisheries occur in a waterway, the focus of the fisheries description is on native fish.

It is important to note that focusing on sport fish habitat does not necessarily exclude native fish. The habitat requirements for the non-native trout are often similar to those of native trout and minnows. Their ranges of suitable temperatures and current velocities overlap greatly. Enhancing or degrading trout habitat would usually create a roughly similar benefit or adverse effect on the habitat for native fish. However, it is recognized that non-native trout compete with the native cutthroat trout (*Oncorhynchus clarki*) and both the non-native and cutthroat trout prey upon native minnows such as the leatherside chub (*Gila copei*).

The aquatic habitats that would be affected by the construction and operation of the Proposed Action, each alternative, and the irrigation distribution and on-farm systems are summarized in Table 3.6-2. The following description of baseline conditions applies to the Proposed Action and all alternatives. A list of sport and non-sport fish occurring within the impact area of influence is provided in Table 3.6-3.

Table 3.6-1
Description of Stream Reaches on Sixth Water Creek, Diamond Fork Creek, and the Spanish Fork River

Major Stream Designations	Component Reaches	Reach Description	Reach Length (miles)
Sixth Water Creek	Upper Sixth Water Creek	Strawberry Tunnel outlet downstream to the Sixth Water Aqueduct outlet	5.87
	Lower Sixth Water Creek	Sixth Water Aqueduct downstream to the confluence with Diamond Fork Creek	3.60
Diamond Fork Creek Above Monks Hollow	Diamond Fork Creek above Three Forks*	Diamond Fork Creek from the proposed Tanner Ridge Tunnel outlet (Proposed Action) downstream to the confluence with Sixth Water and Cottonwood Creeks	2.27
	Diamond Fork Creek below Three Forks	Diamond Fork Creek from the mouth of Sixth Water Creek downstream to Monks Hollow	2.54
Diamond Fork Creek Below Monks Hollow	Segment 1	Diamond Fork Creek from Monks Hollow downstream to just above Diamond Campground	1.3
	Segment 2	Diamond Fork Creek from just above Diamond Campground downstream to Brimhall Canyon	2.2
	Segment 3	Diamond Fork Creek from Brimhall Canyon to the Spanish Fork River	3.7
Upper Spanish Fork River	Weighted average of microhabitat reaches for entire upper Spanish Fork River segment	Spanish Fork River from the mouth of Diamond Fork Creek downstream to the Strawberry Diversion Dam	4.2
Lower Spanish Fork River	Above the East Bench Diversion	Spanish Fork River from the Strawberry Diversion Dam downstream to the East Bench Diversion	1.6
	Below the East Bench Diversion	Spanish Fork River from the East Bench Diversion to the powerhouse near the Mill Race Canal Diversion	2.8
	Below the powerhouse/Mill Race Canal diversion	Spanish Fork River from the powerhouse discharge downstream to Utah Lake	15.6

*Three Forks is the confluence of Diamond Fork Creek, Sixth Water Creek, and Cottonwood Creek (a small and sometimes intermittent stream).

Table 3.6-2
Aquatic Environment Affected by the Proposed Action and Alternatives

Waterway	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Sixth Water Creek	C; O	C; O	O	O	O	O	O
Cottonwood Creek	NA	NA	O	O	O	O	O
Diamond Fork Creek above Three Forks	C	C	O	O	O	O	O
Diamond Fork Creek above Monks Hollow	C; O	C; O	C	C	C	C	C;O
Diamond Fork Creek below Monks Hollow	O	O	O	O	O	O	O
Upper Spanish Fork River	C; O	C; O	C; O	C; O	C; O	C; O	O
Lower Spanish Fork River	C; O; ARF	C; O; ARF	C; O; ARF	O; ARF	O; ARF	O; ARF	O; ARF
Beer Creek/Benjamin Slough	ARF	ARF	ARF	ARF	ARF	ARF	ARF
Spring Creek (tributary of Beer Creek)	ARF	ARF	DSC; ARF	ARF	DSC; ARF	ARF	ARF
Peteetneet Creek	C	C	C	C	C	C	NA
Summit Creek	C	C	C	C	C	C	NA
Salt Creek	O	O	O	O	O	O	NA
West Creek	ARF	ARF	ARF	ARF	ARF	ARF	NA
Burraston Ponds	ARF	ARF	ARF	ARF	ARF	ARF	NA
Upper Currant Creek	ARF	ARF	ARF	ARF	ARF	ARF	NA
Mona Reservoir	O; ARF	O; ARF	O; ARF	O; ARF	O; ARF	O; ARF	NA
Lower Currant Creek	O; ARF	O; ARF	O; ARF	O; ARF	O; ARF	O; ARF	NA

Notes: C = Construction; DSC = Distribution System Construction; O = Project Operation; ARF = Agricultural Return Flows; NA = Not Applicable (i.e., these streams would not be affected by the associated alternatives)

Table 3.6-3
Fish Species Potentially Affected by the SFN System and the Local Development Systems

Sport Fish		Non-Sport Fish	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
brown trout	*Salmo trutta*	least chub*	*Iotichthys phlegethontis*
cutthroat trout*	*Oncorhynchus clarki*	leatherside chub*	*Gila copei*
rainbow trout	*Oncorhynchus mykiss*	Utah chub*	*Gila atraria*
largemouth bass	*Micropterus salmoides*	speckled dace*	*Rhinichthys osculus*
smallmouth bass	*Micropterus dolomieui*	longnose dace	*Rhinichthys cataractae*
green sunfish	*Lepomis cyanellus*	fathead minnow	*Pimephales promelas*
plains killifish	*Fundulus zebrinus*	common carp	*Cyprinus carpio*
white bass/striped bass hybrid	*Morone saxatilis*	golden shiner	*Notemigonus crysoleucas*
white bass	*Morone chrysops*	redside shiner*	*Richardsonius balteatus*
yellow perch	*Perca flavescens*	mountain sucker*	*Catostomus platyrhynchus*
walleye	*Stizostedion vitreum*	mottled sculpin*	*Cottus bairdi*
channel catfish	*Ictalurus punctatus*	western mosquitofish	*Gambusia affinis*
black bullhead	*Ictalurus melas*		
*Native fish			

3.6.5.1 Sixth Water Creek

3.6.5.1.1 Physical/Chemical Characteristics and Instream Habitat. Approximately 9.5 miles of Sixth Water Creek have been heavily influenced by irrigation water releases from Strawberry Reservoir since 1915. From 1915 through 1995, irrigation releases from Strawberry Tunnel entered the upper end of Sixth Water Creek. Since June 1996, these irrigation releases have occurred lower in the creek via the Syar Tunnel and Sixth Water Aqueduct. The non-operational Strawberry Tunnel now provides a continuous 5 cfs of seepage water that supplements the natural flows of 2 to 18 cfs in the 5.9 miles of upper Sixth Water Creek. Prior to 1996, irrigation flows up to 480 cfs scoured the upper Sixth Water Creek channel and degraded its fish habitat (see Table 3.2-1 for pre-1996 historical flows).

Since 1996, these irrigation flows have bypassed the upper reach and now enter through the Sixth Water Aqueduct located 3.6 miles above the creek's mouth. Lower Sixth Water Creek (below the Sixth Water Aqueduct) has continued to be scoured by the same irrigation flows that were previously discharged from Strawberry Tunnel (see Table 3.2-1). These unnaturally high irrigation releases, plus their duration, have scoured most of the channel, degraded its value as fish habitat, and increased stream bank erosion and sediment input.

The Sixth Water Creek channel bed is dominated by bedrock and boulders in the high gradient reach upstream of the Sixth Water Aqueduct and by small boulders and cobble in medium gradients of the lower reach. Substrate suitable for trout spawning is generally absent from the upper reach and is limited in the lower reach. Pool habitat

with sufficient depth and cover for supporting adult trout and providing winter habitat is limited throughout most of this stream.

Irrigation releases from Strawberry Reservoir determine water temperatures in lower Sixth Water Creek from late May through September. Although the following description of baseline temperature characteristics for Sixth Water Creek uses the pre-1996 data (i.e., releases were from Strawberry Tunnel) extracted from Table 3.3-3, observations based on limited 1996 and 1997 temperature data are included where appropriate.

June through September water temperatures in Sixth Water Creek for the historical period of record average 48°F with a maximum of 67°F in the upper end and an average of 49°F with a maximum of 70°F in the creek's lower end (see Table 3.3-3). Water quality is generally good throughout all 9.5 miles of Sixth Water Creek, but turbidity and sedimentation from erosion during rainstorms and high flows reduces instream habitat quality.

3.6.5.1.2 Fish Species Composition. In the mid-1970s, fisheries sampling found the following species of fish in lower Sixth Water Creek: Bonneville cutthroat trout, brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), mountain sucker (*Catostomus platyrhynchus*), longnose dace (*Rhinichthys cataractae*), redside shiner (*Richardsonius balteatus*), and mottled sculpin (*Cottus bairdi*). In 1990, an accidental release of rotenone-treated water from Strawberry Reservoir killed most of the fish in Sixth Water Creek. Since 1991, the Utah Division of Wildlife Resources has made periodic annual stockings of 8,000 fingerling brown trout to restore the trout fishery of this creek (Sakaguchi 1996). Fish sampling conducted in 1994 and 1996 at three locations in upper and lower Sixth Water Creek found brown trout standing crops of 72 to 76 pounds per acre but captured no other trout species (Utah Division of Wildlife Resources 1994c and 1996). In August 1997, the Utah Division of Wildlife Resources electrofished upper Sixth Water Creek above Rays Valley Bridge and below Dip Vat Creek and found trout standing crops of 125 and 301 pounds per acre, respectively (Wiley and Thompson 1997a). The difference in trout biomass between these two sites may be a reflection of sediment input from a highly erosive area located between Dip Vat Creek and Rays Valley Bridge.

The aquatic invertebrate community of all portions of Sixth Water Creek is comprised largely of mayflies, chironimid midge larvae, and oligochaete worms. This community structure is supported by the organic-rich waters from Strawberry Reservoir (irrigation releases and Strawberry Tunnel seepage) that carry phytoplankton and other organic materials (IABAT 1989).

3.6.5.2 Diamond Fork Creek Above Three Forks

3.6.5.2.1 Physical/Chemical Characteristics and Instream Habitat. The 2.27 miles of Diamond Fork Creek from the proposed Tanner Ridge Tunnel outlet to Three Forks has natural flows that range from an average peak flow of 42 cfs in May to a late summer flow of 4 cfs. During drought years, such as those which occurred in the early 1970s, summer flows can be less than 1 cfs. Stream gradient is moderately steep, and the primary substrates are boulders and cobble in a habitat predominated by riffles and rapids. The stream channel is 10 to 15 feet wide and supports a margin of often dense riparian vegetation.

Approximately 600 feet upstream of the western portal of the proposed Tanner Ridge Tunnel on Diamond Fork Creek, a sulfur spring discharges 1 to 2 cfs of warm, mineralized water to the creek. Based on an examination of instream substrates and aquatic invertebrates, it appears that water quality and aquatic habitat in Diamond Fork Creek is degraded by the sulfur spring for approximately 800 feet downstream of the Tanner Ridge Tunnel portal; the length of the impacted area would vary with seasonal flow variations. The sulfur spring has no apparent adverse effect upon the fisheries in the majority of Diamond Fork Creek within the impact area of influence.

3.6.5.2.2 Fish Species Composition. Fish sampling in the mid-1970s found the first 0.2 mile of Diamond Fork Creek above Sixth Water Creek to have 92 pounds per acre of trout consisting of brown, cutthroat, and rainbow trout (USBR 1990). Based on current information on streamflow and instream habitat characteristics, a Binns

Habitat Quality Index (HQI) predicts a trout standing crop of 108 pounds per acre for the 2.27 miles of Diamond Fork Creek above Three Forks. Although the short section below the sulphur spring has an aquatic invertebrate population heavily predominated by filter-feeding black fly larvae (*Simuliidae*, a family tolerant of organic enrichment), most of the creek has a healthy and diverse population of low-tolerance taxa of stoneflies, mayflies, and caddis flies.

3.6.5.3 Diamond Fork Creek Above Monks Hollow

3.6.5.3.1 Physical/Chemical Characteristics and Instream Habitat. The 2.54 miles of Diamond Fork Creek between Three Forks and Monks Hollow receive irrigation flows from Sixth Water Creek from late April through September. The average monthly baseline flows for this reach are 12 to 18 cfs in the late fall and winter and average 120 to 293 cfs from May through September. Historical water temperatures for this reach average 49°F with a maximum of 70°F. The stream gradient is moderate, and riffles and rapids predominate along with substrates of small to medium boulders and cobble. The stream channel lies in a relatively narrow canyon and is typically 20 to 30 feet in width.

3.6.5.3.2 Fish Species Composition. While this reach above Monks Hollow has not been sampled since the 1990 release of Strawberry Reservoir's rotenone-treated water, the Utah Division of Wildlife Resources electrofished Diamond Fork Creek approximately 1.5 miles downstream of Monks Hollow in the fall of 1997. The trout population below Monks Hollow was estimated at 73 pounds per acre and consisted of mostly brown trout with lesser numbers of cutthroat and rainbow trout (Wiley and Thompson 1997b). As the Utah Division of Wildlife Resources' 1994 estimate of trout in Sixth Water Creek just above Three Forks was 72 pounds per acre (Utah Division of Wildlife 1994c), it appears safe to estimate the trout biomass of this reach between Three Forks and Monks Hollow at 72 pounds per acre.

3.6.5.4 Diamond Fork Creek Below Monks Hollow

3.6.5.4.1 Physical/Chemical Characteristics and Instream Habitat. Three distinct geomorphic reaches exist in this 7.2-mile reach and are described as Segments 1, 2, and 3. Segment 1 extends 1.3 miles downstream from Monks Hollow to just above the Diamond Fork Campground. This entrenched, single channel has low sinuosity and a relatively gentle gradient of 1.3 percent. Segment 2 continues another 2.2 miles downstream to Brimhall Canyon. A moderately entrenched single channel, it has low sinuosity and its gradient has decreased to 0.85 percent. Segment 2 contains multiple channels and abandoned meander patterns in some locations. Segment 3 is from Brimhall Canyon downstream 3.7 miles to Highway 6, where it empties into the Spanish Fork River. Although this lowermost segment has a gradient similar to Segment 2 (0.85 percent), it is noticeably different from the upper segments in that it is dominated by multiple channels that experience repeated and large lateral movement. Massive erosion of stream banks and instream scouring associated with high irrigation flows of 200 to 300 cfs have created a wide and unstable, braided stream channel. Following the irrigation season, flows drop to a base level of 12 to 18 cfs through the late fall and winter months (see Table 3.2-1).

Because most of the water in Diamond Fork Creek during the irrigation season consists of water from Strawberry Reservoir, irrigation releases have a large effect on water quality below Three Forks. Historical water temperatures for this reach average 49°F and reach a maximum of 70°F (see Table 3.3-3). Should Strawberry Reservoir irrigation releases be from below the thermocline, Diamond Fork Creek's temperatures for June through July would likely be in the range of the mid-40s to low 50s. Although an exact figure is not available, it appears that irrigation releases from below the Strawberry Reservoir thermocline were an infrequent event during the period of record.

Riffle habitat dominates all segments of Diamond Fork Creek below Monks Hollow. Riffles comprise 60 percent of Segments 1 and 2 and 77 percent of Segment 3. Run habitat is the second most common habitat and comprises 20 percent of each segment. Main channel pool habitat is infrequent, with Segment 1 being the only section

having a significant number of pools in its main channel. Segment 3 is comprised of 23 percent pool habitat, but most of these pools are in side channels as cutoff pool habitat. The cutoff pools provide important habitat to the fisheries of lower Diamond Fork Creek. The high percentage of gravel and rubble in Segment 3 provides excellent spawning habitat for trout, but a general lack of pool habitat and object cover results in poor to fair trout habitat conditions throughout the Diamond Fork Creek channel subjected to years of high irrigation flows (IABAT 1990).

3.6.5.4.2 Fish Species Composition. The 1997 sampling of Segments 1 through 3 found the trout population to be 87 percent brown trout, 12 percent cutthroat trout, and 1 percent rainbow trout. The rainbow trout present are primarily hatchery-reared fish stocked as "catchables" (8 to 11 inches in total length). Estimates of the wild trout biomass for Segments 1 through 3 are 70, 127, and 73 pounds per acre, respectively (Wiley and Thompson 1997b). Non-game fish found here during the 1997 sampling include mountain sucker and mottled sculpin.

3.6.5.5 Upper Spanish Fork River

3.6.5.5.1 Physical/Chemical Characteristics and Instream Habitat. From its confluence with Diamond Fork Creek, the Spanish Fork River flows approximately 20 miles to Utah Lake. During the irrigation season (typically April 15 to October 15), the SWUA and the Spanish Fork River companies divert most of the Spanish Fork River flow into the High Line Canal via the Strawberry Diversion Dam, which is located 4.2 river miles below the confluence of the Spanish Fork River and Diamond Fork Creek.

Streamflow in the upper Spanish Fork River is comprised of water from the upstream Spanish Fork River basin and inflow from its tributary, Diamond Fork Creek. During the late fall, winter, and spring, the majority of flow in the Spanish Fork River below the mouth of Diamond Fork Creek is from the upper Spanish Fork River. From June to early September, irrigation flow releases from Strawberry Reservoir down Diamond Fork Creek comprise most of the upper Spanish Fork River's 250 to 460 cfs flow. Baseline average monthly flows for the upper Spanish Fork River are 67 to 82 cfs (see Table 3.2-1).

Water quality in this stream reach is suitable for maintaining a coldwater fishery year-round (average temperature of 52°F), although July and August water temperatures have occasionally reached 75°F and push the upper limit for trout (see Table 3.3-3). A habitat limitation appears to be the high turbidity associated with high flows resulting from spring runoff and heavy rainstorms in the watershed and from high flow releases for delivery of irrigation water. High turbidity from Diamond Fork Creek irrigation releases and turbid water from Halls Fork, Diamond Fork, Soldier Creek, and the Thistle Creek slide area during storm events result in turbidity problems (Sakaguchi 1993). The Utah Division of Water Quality (1994c) designates these waters as being protected for secondary contact recreation (i.e., boating, wading, or similar uses), coldwater species of game fish, and agricultural use.

Approximately 20 percent of the 4.2 miles of river channel is channelized (i.e., straightened and the banks stabilized with stone riprap), and even in the unchannelized portions, riffle habitat predominates. The majority of trout habitat occurs in the primary channel along stream banks where rocks and tree roots create shelter for trout. The channel substrate are predominately sand and gravel, small cobble, and occasional patches of small boulders.

The fishery has been degraded by high flows released from the SVP during the irrigation season and low flows at other times of the year. The Utah Division of Wildlife Resources has classified this stream reach as a Class 3 fishery, which is defined as a stream having "high priority" relative to habitat value, where "fisheries should be enhanced when possible and losses should be minimized" (Nelson et al. undated).

3.6.5.5.2 Fish Species Composition. The upper Spanish Fork River fisheries include brown trout, cutthroat trout, mountain sucker, mottled sculpin, an occasional rainbow trout, and hybrids of rainbow/cutthroat trout. Electrofishing efforts at several sites on the upper Spanish Fork River in 1994 found the trout population to be

mostly brown trout and to range in standing crop biomass from 4.7 to 17.1 pounds per acre. The average trout standing crop for this 4.2-mile reach, based on the 1994 electrofishing results, is 8.1 pounds per acre.

Aquatic invertebrates form the majority of the prey base for the fish population of the river. Sampling of the upper Spanish Fork River was conducted in March and November of 1980 (USBR 1983). The March samples reflected the natural upper Spanish Fork River aquatic invertebrate community, while the November samples were largely influenced by high upstream discharges. When the irrigation flow releases are occurring, the upper Spanish Fork River has a greater number of species and greater density because of those species drifting downstream with the water released from Strawberry Reservoir (*Amphipoda, Copepoda, Ostracoda, Hydroptila* spp., and *Simuliidae*). The dominant invertebrates occurring prior to the irrigation season include mayflies of the genera *Baetis, Rhithrogena*, and *Ephemerella*; stoneflies of the genera *Prostoia, Pteronarcella*, and *Isoperla*; caddis flies of the genera *Hydropsyche* and *Brachycentrus*; and various chironomids.

3.6.5.6 Lower Spanish Fork River

3.6.5.6.1 Physical/Chemical Characteristics and Instream Habitat. The lower Spanish Fork River flows below the Strawberry Diversion Dam are largely deliveries of irrigation water to the various downstream diversions, plus accretion flows from natural seeps and irrigation return flows. The average lower Spanish Fork River flows at the Lake Shore gaging station are shown in Table 3.2-1, Section 3.2, Water Resources. Most of the summer flow recorded at this gage consists of irrigation return flows.

Flows in the lower Spanish Fork River are complicated because of the numerous diversions. The 4.4 miles of channel between the Strawberry Diversion and the Mill Race Canal Diversion is a bypass reach for hydropower generation, except during the irrigation season. Immediately below the lowermost diversion on the river, Huff Dam peak flows of about 130 to 200 cfs occur in March through May, and low flows of 3 cfs occur in July and August. Below the various diversions along the lower Spanish Fork River, instream flows often consist of seepage and irrigation return flows.

Water quality in the lower Spanish Fork River fluctuates significantly from season to season and deteriorates considerably in its lower reaches during certain times of the year. Because of low flows and irrigation return flows, the lower reaches of the Spanish Fork River experience high TDS and nutrient levels with periodic increases in BOD and coliform levels. Water temperatures in the lower river average 57°F but may be as high as 84°F (see Table 3.3-3). Livestock and urban runoff also contribute to the pollutant load of this lower reach (USBR 1984).

Instream habitat of the lower Spanish Fork River is primarily low gradient, 20 to 40 feet wide, with a silt and sand substrate. A thin strip of riparian vegetation exists along portions of the creek. Low flows and warm water temperatures make this marginal or nonexistent habitat for coldwater fish.

3.6.5.6.2 Fish Species Composition. The lower Spanish Fork River fisheries are severely constrained by low flows throughout most of the year. The first 6 miles of the stream below the Strawberry Diversion Dam are classified as Class 3 fishery habitat, and the lowermost 14 miles are classified as Class 6 fish habitat. The Utah Division of Wildlife Resources describes a Class 6 stream as "those stream channels which are dewatered for significant time periods during the year." Portions of the lower Spanish Fork River support marginal brown trout and cutthroat trout fisheries (Sakaguchi 1994; Shirley 1994). The 1.6 miles of river immediately below the Strawberry Diversion Dam are annually dewatered and presently support no significant numbers of trout. The 2.8-mile reach between the Bench Diversion and the powerhouse also suffers from low winter flows, but spring seepage of 3 cfs allows the reach to support 5 pounds per acre of trout (USBR 1990).

The most abundant fish species in the lowermost portions of the river is carp (*Cyprinus carpio*). Small numbers of other fish found in the lower end of the Spanish Fork River by the Division of Wildlife Resources include

channel catfish (*Italurus punctatus*), black bullhead (*Ictalurus melas*), walleye (*Stizostedion vitreum*), white bass (*Morone chrysops*), and cutthroat trout (Sakaguchi 1994).

3.6.5.7 Peteetneet Creek

Peteetneet Creek is the next significant drainage south of the Spanish Fork River within the impact area of influence (see Map 1-4). Flowing northwest down Payson Canyon, Peteetneet Creek is diverted for hydroelectric power generation and again for consumptive use.

3.6.5.7.1 Physical/Chemical Characteristics and Instream Habitat. Instream habitat below the hydroelectric powerhouse consists of an abundance of small to medium boulders in a 10- to 15-foot-wide channel of medium gradient. Because of water diversions, this section of the channel is dry throughout the summer.

3.6.5.7.2 Fish Species Composition. Above its diversion structure, Peteetneet Creek contains cutthroat and rainbow trout, the latter including wild fish and stocked fish (Sakaguchi 1994). Below the diversion structure, there is insufficient surface water year-round to support a fishery.

3.6.5.8 Beer Creek

3.6.5.8.1 Physical/Chemical Characteristics and Instream Habitat. Beer Creek is fed by a series of springs near the city of Salem and supplemented by the outflow of Salem Pond, an impounded spring area (see Map 1-4 for general location). Beer Creek flows about 4 miles before receiving inflow from Spring Creek. Spring Creek, a tributary of Beer Creek, originates from various springs including a complex known as Holladay Springs. Its primary channel is 6 to 7 miles in length before entering Beer Creek. Downstream of its Spring Creek confluence, Beer Creek is called Benjamin Slough, and it drains into Utah Lake. Flows in Beer Creek are generally low during the summer months. See Table 3.2-1 in Section 3.2, Water Resources, for a representation of the streamflow characteristics of Beer Creek. The stream is heavily influenced by irrigation, channelization, and other human uses. Water quality is also degraded as a result of agricultural practices, grazing, and high nutrient levels. The overall stream habitat is poor and maximum temperatures reach 82°F (see Table 3.3-3).

3.6.5.8.2 Fish Species Composition. Poor quality substrate (silt), high turbidity, elevated temperatures, and high salinity levels from irrigation return flows all limit the ability of Beer Creek to support game fish (see Table 3.3-3). Sampling of 15 stations on this creek in late summer 1994 found green sunfish to comprise the great majority of the fish population of the upper and lower portions (Benjamin Slough) of the creek, with fathead minnow (*Pimephales promelas*) being the second most prevalent fish. No native fish were found in Beer Creek during the 1994 sampling.

The 1994 sampling of 26 sites on Spring Creek and the Holladay Springs complex found 12 fish species, 61 percent of which were native. Leatherside chub comprised 38 percent of the total number of fish captured. The second and third most abundant fish captured were fathead minnow and speckled dace (*Rhinichthys osculus*), respectively.

The Division of Wildlife Resources has classified the lower section of Beer Creek (Benjamin Slough) as a Class 5 stream relative to its fisheries. In the Utah Division of Wildlife Resources' description of stream classifications, a Class 5 stream is noted as "now practically valueless to the fishery resource" (Nelson et al. undated). The upper section of Beer Creek (6.9 miles) above the Spring Creek confluence is a Class 4 stream, meaning it is "typically poor in quality, with limited fishery value" (Nelson et al. undated).

3.6.5.9 Summit Creek

South of Payson Canyon, Summit Creek flows through Santaquin Canyon to the town of Santaquin. Summit Creek flows are diverted 0.8 mile upstream of the mouth of Santaquin Canyon and enter a buried pipeline.

3.6.5.9.1 Physical/Chemical Characteristics and Instream Habitat. Based on the State's classification system and a late summer reconnaissance survey, water quality is suitable for trout throughout most of the stream length having surface flow. Summit Creek above Santaquin is designated as protected for secondary contact recreation, coldwater fish species, and agricultural uses (Utah Division of Water Quality 1994c).

The original stream channel between the diversion at the mouth of Santaquin Canyon and I-15 is 3 to 4 feet wide, is mostly enclosed by riparian vegetation, and has a substrate of large gravel and small cobble. In places, the channel is vegetated throughout with grass and appears as a swale. Concrete debris dumped along the channel has degraded portions of the creek.

3.6.5.9.2 Fish Species Composition. Above its diversion structure, Summit Creek supports populations of rainbow and brown trout and is rated as a Class 3 stream relative to its fish habitat. The Class 3 designation means that the aquatic habitat value should be given a "high priority" for protection. Below the diversion structure, a lack of year-round surface water precludes the existence of a fishery.

3.6.5.10 Salt Creek

Originating in the Nebo Basin of the Wasatch Range, Salt Creek below the mouth of Salt Creek Canyon east of the city of Nephi has three diversion channels. Map 1-12 shows the various channels below the mouth of Salt Creek Canyon.

Most of the water not diverted at the mouth of Salt Creek Canyon flows in a naturalized ditch (Salt Creek Ditch) through Nephi for 1.5 miles, then enters two smaller irrigation ditches (approximately 4 feet in width) that lie adjacent to the railroad tracks on the west side of the city. One of these ditches transports water south and the other flows north, in both cases adjacent to the railroad tracks.

3.6.5.10.1 Physical/Chemical Characteristics and Instream Habitat. The average monthly baseline flows in Salt Creek are shown in Table 3.2-1 of Section 3.2, Water Resources. The average annual flow for the Salt Creek Ditch is calculated as 24 cfs, and water quality is suitable for coldwater fish with a maximum temperature of 70°F (see Table 3.3-3).

The instream habitat of the Salt Creek Ditch consists of mostly low gradient riffles and runs with instream cover provided by small cobble, undercut banks, and riparian vegetation bordering the 11-foot-wide channel. Sand and silt are significant components of the substrate.

3.6.5.10.2 Fish Species Composition. Below the diversion structure, the primary Salt Creek Ditch through Nephi supports a wild brown trout fishery utilized by local residents. This population is supported by natural reproduction, as the Utah Division of Wildlife Resources does not stock this stream with trout.

In August 1993, the Utah Division of Wildlife Resources electrofished a 528-foot length of the Salt Creek Ditch between I-15 and eastern Nephi. They found evidence of brown trout reproduction, and most of the 57 brown trout captured ranged in length from 8 to 11 inches. Based on these data, they computed a population estimate of 724 brown trout per mile and, using the Binns HQI, computed a predicted trout standing crop of 52 pounds per acre. The only other species of fish captured was mottled sculpin. At the west end of Nephi, brown trout occur in the north- and south-flowing irrigation ditches for a distance of approximately 800 feet north and south of the main Salt Creek Ditch.

3.6.5.11 *Upper Currant Creek*

3.6.5.11.1 Physical/Chemical Characteristics and Instream Habitat. The headwaters of upper Currant Creek originate in several springs north of Nephi and flow north into Mona Reservoir (see Map 1-4). This portion of the creek above Mona Reservoir can be segmented into three sections based on flow and fish distribution. The uppermost reach of Currant Creek is above the outflow of Burraston Ponds. This reach of stream is heavily used for irrigation and contains several channels and numerous springhead pools. The second reach, located immediately below this short section, is spread into multiple irrigation ditches that do not provide suitable fish habitat. The third component of upper Currant Creek occurs where irrigation return flows and the Burraston Ponds outflow create a permanent stream to Mona Reservoir. Average annual flows are presented in Table 3.2-1 in Section 3.2, Water Resources.

Water temperatures at sampling sites in the Currant Creek drainage ranged from 50°F to 88°F during the 1994 survey (Holden et al. 1994). Lowest temperatures were generally associated with springs and springhead ponds. Conductivities in Currant Creek ranged from 340 to 2,650 micromhos per centimeter (μmhos/cm) (224 to 1,749 ppm TDS).

The Utah Division of Water Quality (1994c) designates upper Currant Creek and its tributaries as protected for secondary contact recreation, coldwater fish species, and agricultural uses. These creeks generally meet the numeric criteria for these use designations except that stream temperatures (maximum of 88°F) frequently exceed the 68°F standard during summer months.

3.6.5.11.2 Fish Species Composition. The springhead pools and small streams of the uppermost segment of Currant Creek are dominated by the introduced plains killifish (*Fundulus zebrinus*) (also known as the zebra killifish). The native speckled dace and Utah chub (*Gila atraria*) are found in only one short (0.25 mile) section of stream that contains the best flows and habitat (Holden et al. 1994). Within the Burraston Ponds-Mona spring complex is a springhead containing a population of least chub and fathead minnow. Fish found in the remaining portion of upper Currant Creek include Utah chub, carp, black bullhead, suckers, speckled dace, and killifish (USBR 1987b). Rainbow trout from Burraston Ponds and fish in Mona Reservoir occasionally move into this section of creek as well.

3.6.5.12 *West Creek*

3.6.5.12.1 Physical/Chemical Characteristics and Instream Habitat. West Creek flows north along the west side of Nephi Valley and receives most of its flow from irrigation return flows and small springs (see Map 1-4 for site location). West Creek is a tributary to Currant Creek during higher flow times, but during the summer of 1994, it experienced dried-up flow, extremely high salinity, and poor overall habitat conditions because of grazing.

During the late summer survey in 1994, water temperatures measured at various sample sites in the West Creek drainage ranged from 57°F to 86°F (Holden et al. 1994). Lowest temperatures were generally found at springhead locations, while high temperatures were observed at many locations in the drainage, particularly in remnant pools and reaches of the mainstem creek with little flow.

Conductivities in the West Creek drainage range from 420 to 16,000 μmhos/cm (277 to 10,400 ppm TDS). Unusually high conductivities (greater than 10,000 μmhos) were generally observed in isolated, stagnant pools in mainstem West Creek. Spot measurements of salinity at these locations indicated levels of TDS as high as 7,000 ppm at some locations. Turbidity varied widely, depending on land use, with highest turbidities typically observed in areas where livestock had access to the water.

3.6.5.12.2 Fish Species Composition. The stream is dominated by the introduced plains killifish and fathead minnow. Only two native species were collected during the summer of 1994: Utah chub and speckled dace. Only two speckled dace were found, and Utah chub were relatively common only in two short sections.

3.6.5.13 Burraston Ponds and Mona Reservoir

3.6.5.13.1 Physical/Chemical Characteristics and Instream Habitat. Burraston Ponds consist of three adjacent spring-fed ponds located on the Juab Valley floor approximately 2.5 miles south of Mona Reservoir (see Map 1-4 for location). The ponds are 0.75, 1.0, and 7.3 surface-acres in size. Burraston Ponds are owned and managed by the Utah Division of Wildlife Resources and are open to public recreation. Currant Creek (also called Burraston Creek) flows adjacent to Burraston Ponds and receives overflow and seepage from these ponds, eventually draining into Mona Reservoir. Water quality is suitable for supporting coldwater fish. Salinity as TDS averages 764 ppm.

Mona Reservoir has a surface area of 1,774 acres at maximum capacity and is used to store water for irrigation demands in the Elberta and Goshen areas. As such, it undergoes extreme seasonal water level fluctuations as a result of irrigation water releases. Much of the water that enters the reservoir comes from springs and return flows from irrigated lands in the valley. Currant Creek is the main source of surface water inflow to the reservoir. Typical salinity as TDS is approximately 850 ppm.

3.6.5.13.2 Fish Species Composition. Burraston Ponds support a rainbow trout fishery comprised of hatchery fish. The ponds may also contain Utah chub, carp, and redside shiner. The fisheries potential of Mona Reservoir is limited by the lack of a minimum pool. During drought years, the reservoir is completely drained. Prior to going dry in 1992, its fisheries consisted of walleye, smallmouth bass (*Micropterus dolomieui*), black bullhead, Utah chub, and carp. After Mona Reservoir was refilled in 1993, the Utah Division of Wildlife Resources stocked it with yellow perch (*Perca flavescens*) and a white bass/striped bass hybrid (Sakaguchi 1994). Also reported to occur in Mona Reservoir in 1993 were fathead minnow and plains killifish.

3.6.5.14 Lower Currant Creek

3.6.5.14.1 Physical/Chemical Characteristics and Instream Habitat. Also known as Goshen Creek, lower Currant Creek consists of a 1.9-mile reach from the Mona Reservoir Dam to the Currant Creek Irrigation Company's diversion structure and a 5.7-mile reach from this diversion structure to Goshen Reservoir. Approximately 1 mile below the Mona Reservoir Dam, the creek enters Goshen Canyon and exits the canyon 3.5 miles below the dam. At the upper end of Goshen Canyon are springs that provide 2 to 3 cfs of instream flow; above the springs, flow is seasonally intermittent. The average monthly flows in this reach immediately below the dam (prior to the spring inflow) for the period of 1930 to 1973 ranged from a low of 3 cfs in December to a high of 60 cfs in May (see Table 3.2-1). The primary difference in the monthly flow regime between wet and dry or average water years is that during wet years, the hydrograph peaks in February, with a secondary peak in May.

During the irrigation season, the Currant Creek Irrigation Company diverts up to 38 cfs at the location noted above. The estimated historical monthly flows below the diversion range from zero cfs in August through October to 25 cfs in May. Flows in the creek are controlled mainly by releases from Mona Reservoir and the downstream diversions. The low flows, along with livestock grazing and its effect on stream banks, lower the productivity of the stream (USBR 1986).

The maximum salinity of these waters is reported as 1,152 ppm TDS with an average of 966 ppm TDS. Dissolved oxygen averages 9.1 ppm, and the minimum level is recorded as 5.0 ppm. Water temperature averages 59°F with a high of 88°F. The Utah Division of Water Quality (1994c) designates this creek from Mona Reservoir to the mouth of Goshen Canyon as protected for coldwater species of game fish, a designation that sets a maximum

temperature criterion of 68°F. This criterion is frequently exceeded as its source water, Mona Reservoir, often exceeds this temperature.

3.6.5.14.2 Fish Species Composition. Information on the fisheries composition of this creek is limited to the Utah Division of Wildlife Resources' database record of fish sampling conducted in 1972, 1975, and 1992. The 1992 sampling was from the Juab-Utah county line upstream to Mona Reservoir. Mountain sucker was the predominant species, but also present were sculpin, rainbow trout (probably fish stocked for the "put and take" trout fishery below Mona Reservoir), carp, Utah chub, speckled dace, and a brown trout. The 1975 sampling occurred from the county line north and found mostly mountain suckers, Utah chub, sculpin, and speckled dace. Sampling in 1992 occurred at five locations in the 1.5-mile reach below Mona Dam and found the most abundant fish to be fathead minnow, carp, Utah sucker, and mountain sucker. During the spring, the Utah Division of Wildlife Resources typically stocks 500 catchable-size rainbow trout in lower Currant Creek immediately below Mona Dam.

3.6.6 Impact Analysis

As noted previously, sport fish were used as indicator species to assess the overall health of the aquatic system found in the impact area of influence. The analyses methods employed to assess potential impacts to the aquatic resources in this area, the Montana Method and Binns HQI, are comprehensive methods that evaluate the instream flow needs of the entire aquatic system, including invertebrates and riparian vegetation. Analysis output for the Binns HQI is expressed in terms of standing crop of trout, where trout are used as an indicator species for the coldwater aquatic ecosystem. Trout habitat in Diamond Fork Creek below Three Forks was also assessed using the Incremental Flow Instream Methodology (IFIM). In addition to the effect of instream flow changes on the aquatic biota, water quality concerns of temperature, turbidity, nutrient levels, dissolved oxygen, salinity (as TDS), and trace metals were evaluated. The impact analysis has been categorized according to construction-related impacts and operation-related impacts.

3.6.6.1 Significance Criteria

Listed below are the significance criteria used to determine if the construction or operation of the Proposed Action or alternatives would have a significant impact on aquatic biota or its habitat. An impact is considered significant if one of the following would occur:

- A long-term (in excess of 1 year) reduction in sport fish numbers and/or biomass is likely to occur in an affected stream section as a result of change in habitat conditions (both quantity and quality of instream flows) as defined by the Montana Method relationships of percent mean annual flow to aquatic resource maintenance, or as defined by the Binns HQI as a greater than 5 percent reduction in trout standing crop.

- The Utah Water Quality Standards (February 14, 1994, Adopted Revisions) for the protection of aquatic life are violated because discharges from construction sites cause a 10 NTU increase in the turbidity of the receiving waters (Utah Division of Water Quality 1994c).

- The Utah Water Quality Standards (February 14, 1994, Adopted Revisions) for the protection of aquatic life are violated because waters classified as 3A (protected for coldwater fish) are caused to have temperatures in excess of 68°F (81°F for waters classified 3B [warmwater fisheries]) (Utah Division of Water Quality 1994c). Should existing temperatures periodically exceed this standard, the assessment of impact significance would be based on the frequency and duration that the existing temperature levels are exceeded.

- The Utah Water Quality Standards (February 14, 1994, Adopted Revisions) for the protection of aquatic life are violated because waters classified as 3A have dissolved oxygen concentrations of less than a

30-day average of 6.5 ppm, a 7-day average greater than 5.0 ppm or less than 9.5 ppm, or a 1-day average greater than 4.0 ppm or less than 8.0 ppm (Utah Division of Water Quality 1994c). For waters classified as 3B, the dissolved oxygen standards are a 30-day average of 5.5 ppm, a 7-day average of 4.0 to 6.0 ppm, and a 1-day average of 3.0 to 5.0 ppm (Utah Division of Water Quality 1994c).

- Construction or operation causes waters supporting trout to exceed 2,000 ppm TDS or causes waters supporting fish other than trout to exceed 5,000 ppm TDS (this is a professional judgement standard based on McKee and Wolf [1963]). The State of Utah has not adopted water salinity standards for the protection of fisheries (Utah Division of Water Quality 1994c).

The significance of any impacts on potentially limiting aquatic habitats (i.e., sensitive spawning areas) were assessed through professional judgement. Assessments of potential impacts from changes in water quality were based on tolerance levels from the professional literature.

3.6.6.2 Potential Impacts Eliminated from Further Analysis

There is no potential for direct impacts to aquatic resources associated with the construction and operation of the recreation trail (part of the Proposed Action and MCAP Alternative) other than potential impacts caused by the crossing of Peteetneet Creek, which is discussed below.

No direct impacts to aquatic resources would result from improvements to on-farm systems or the construction of M&I distribution systems. As a result of the Proposed Action and the MCAP and MCATC Alternatives, construction of Lateral 20 distribution pipeline would cross Spring Creek and could potentially impact native non-game fish through erosion and sedimentation. However, this would be avoided by adherence to the construction procedures described in Chapter 1. Indirect impacts associated with M&I distribution and on-farm systems are considered under operation-related impacts.

3.6.6.3 Proposed Action

The following sections describe the construction- and operation-related impacts resulting from the Proposed Action. These impacts are summarized in Section 3.6.6.11. Because the Bonneville Unit water that would be supplied by the Proposed Action would be delivered for distribution by M&I and irrigation distribution systems, the operation impacts identified in the following sections include both direct and indirect impacts of water (M&I and irrigation) being conveyed in waterways and returned (via irrigation return flows) into waterways located within the impact area of influence.

3.6.6.3.1 Construction Impacts

3.6.6.3.1.1 "Diamond Fork Tunnel Alternative." The Proposed Action would require the construction of one siphon, two tunnels, and a pipeline in the Diamond Fork drainage upstream of Monks Hollow. Construction of the Sixth Water Siphon on Sixth Water Creek and the Diamond Fork Siphon on Diamond Fork Creek above Three Forks would require the excavation of soil and rock near and across the streambed of these two creeks. Construction of the Red Hollow Pipeline would also disturb soil that could eventually enter Diamond Fork Creek through ephemeral and intermittent tributary streams. The disturbed soil would have the potential for entering Sixth Water and Diamond Fork Creeks during storm events and, if in sufficient quantity, degrading habitat for invertebrates and fish through sedimentation.

Other potential sources of sediment input and chemical contaminants would be the construction staging areas. A 6-acre staging area for the Diamond Fork Siphon may be sited on a flat located along Diamond Fork Creek about 0.6 mile upstream of Monks Hollow. A 2-acre staging area for the Tanner Ridge Tunnel outlet may be sited on a flat near Diamond Fork Creek above Three Forks, and a new 0.3-mile access road to the Red Mountain Tunnel

outlet would disturb 2 acres of land on the flats at the upper end of Red Hollow. Adhering to the best management practices for construction procedures (described in Chapter 1) would prevent excessive input of sediment from these sources of disturbed soil as well as the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures would reduce the potential for these types of construction-related fishery impacts to insignificant.

The instream excavations for the two siphons would minimize the potential for excessive sedimentation by using coffer dams and limiting instream construction activities to base flow conditions of 7 to 9 cfs for Sixth Water Creek (i.e., during the late October shutdown of Syar Tunnel for maintenance) and less than 3 cfs for Diamond Fork Creek above Three Forks. Additionally, following the best management practices for construction procedures would prevent excessive input of sediment and the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures would reduce the potential for construction-related fishery impacts to insignificant.

Construction of Tanner Ridge and Red Mountain Tunnels would create rock waste materials that would be removed from the immediate vicinity of the tunnel portals and properly disposed in a manner to prevent sediment input to adjacent drainages. These material disposal areas would be placed far enough away from live drainages that the potential for fishery impacts is considered insignificant.

3.6.6.3.1.2 Main Conveyance Aqueduct and Associated Facilities. No SFN System facilities or staging areas would be located along the upper Spanish Fork River. The Main Conveyance Aqueduct crossing of the Spanish Fork River near the Strawberry Diversion Dam and subsequent streams to the south (i.e., Peteetneet and Summit Creeks, and the ephemeral streams, North, Mona, and Willow Creeks) would adhere to the construction procedures discussed in Chapter 1. The same procedures would also apply to the construction of the Currant Creek Distribution Pipeline that would be buried in an existing roadway and twice cross lower Currant Creek. These measures are designed to prevent excessive loading of sediment and the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, and paints. Additionally, the locations of the proposed pipeline crossings of the lower Spanish Fork River, Summit Creek, and lower Currant Creek do not support year-round fisheries because of upstream diversions. This fact, plus the implementation of construction procedures to protect against sediment and chemical input, would result in there being no significant impacts to fisheries from construction activities.

3.6.6.3.1.3 Related Actions (Local Development). No construction impacts would result from construction of local development facilities except for the construction of the diversion structure and pumping plant on Salt Creek in Nephi. The diversion structure would not create an impoundment, but the footprint of this structure and a portion of the pumping plant would eliminate 0.01 acre of riverine habitat within the stream channel. This habitat loss, plus the temporary increase in turbidity associated with the construction activities, would result in no significant impact to the fisheries of Salt Creek. Construction activities on Salt Creek would adhere to the construction procedures discussed previously.

3.6.6.3.2 Operation Impacts

3.6.6.3.2.1 Upper Sixth Water Creek. CUPCA has mandated that flows in upper Sixth Water Creek be released from the Strawberry Tunnel of 25 cfs from November through April and 32 cfs from May through September (see Table 3.6-4). These flows would increase trout standing crop from the baseline condition of 213 pounds per acre to an estimated 356 pounds per acre (see Table 3.6-5). Part of this enhancement would be derived from the increased proportion of streamflow from Strawberry Reservoir water with its higher levels of nitrogen and phosphorus than occur in the local runoff waters.

Table 3.6-4
Comparison of Mean Monthly Flows Used in the Binns HQI Analysis for Sixth Water Creek and Diamond Fork Creek Above Monks Hollow (cfs)

Project Alternative by Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Upper Sixth Water Creek[a]												
Baseline (Post-1996)	6	7	6	7	7	8	14	23	14	8	7	7
Proposed Action and MCAPW-DFT Alternative	34	27	27	27	27	28	34	49	43	36	34	34
All remaining alternatives	34	27	27	27	27	28	34	49	40	35	34	34
Lower Sixth Water Creek[b]												
Baseline	27	8	7	7	7	8	17	90	227	275	194	108
Proposed Action and MCAPW-DFT Alternative	34	28	27	27	28	28	36	51	45	36	34	34
MCAP, MCAPW, MCATC, MCAT Alternatives	124	63	62	61	59	51	80	272	556	632	552	303
No Action Alternative	66	268	280	285	277	250	113	133	265	324	251	236
Diamond Fork Creek Below Three Forks[c]												
Baseline	39	16	14	12	14	18	67	179	271	293	207	120
Proposed Action and MCAPW-DFT Alternative	46	40	38	37	39	43	85	139	86	50	44	45
MCAP, MCAPW, MCATC, MCAT Alternatives	All stream habitat in this reach would be inundated by Monks Hollow Reservoir											
No Action Alternative	60	60	60	60	60	60	88	144	99	80	80	80

[a]Strawberry Tunnel downstream 5.87 miles to the Sixth Water Aqueduct.
[b]Sixth Water Aqueduct downstream 3.6 miles to Diamond Fork Creek (does not include Fifth Water Creek inflow of 3 to 26 cfs).
[c]Sixth Water Creek downstream 2.54 miles to the Monks Hollow.

Table 3.6-5
Binns HQI Assessment for Sixth Water Creek and Diamond Fork Creek Above Monks Hollow

Project Alternative by Stream Reach	Average Width (ft)	Habitat Lost to Inundation (acres)	Lb/Acre	Lb/Reach	Change from Baseline (lb/reach)
Upper Sixth Water Creek[a]					
Baseline	22	0	213	3,351	
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives	25	0	356	6,365	+3,014
Lower Sixth Water Creek[b]					
Baseline	22	0	72	691	
Proposed Action and MCAPW-DFT Alternative	26	0	296	3,358	+2,667
MCAP, MCAPW, MCATC, and MCAT Alternatives	28	0.8	99	1,210	+519
No Action Alternative	44	1.01	112	2,150	+1,459
Cottonwood Creek[c]					
Baseline	6	0	108	11	
Proposed Action and MCAPW-DFT Alternative	No change from baseline conditions				
MCAP, MCAPW, MCATC, and MCAT Alternatives	6	0.1	108	0	-11
No Action Alternative	6	0.1	108	0	-11
Diamond Fork Creek Above Three Forks[d]					
Baseline	13	0	108	357	
Proposed Action and MCAPW-DFT Alternative	No change from baseline conditions				
MCAP, MCAPW, MCATC, and MCAT Alternatives	13	0.30	108	325	-32
No Action Alternative	13	0.5	108	303	-54
Diamond Fork Creek Below Three Forks[e]					
Baseline	23	0	72	510	
Proposed Action and MCAPW-DFT Alternative	25	0	247	1,901	+1,391
MCAP, MCAPW, MCATC, and MCAT Alternatives	Monks Hollow Reservoir	7.1	0	0	-510
No Action Alternative	25	0	192	1,478	+968

[a]Strawberry Tunnel downstream 5.87 miles to the Sixth Water Aqueduct.
[b]Sixth Water Aqueduct downstream 3.6 miles to Diamond Fork Creek.
[c]The mouth of Cottonwood Creek upstream to the uppermost end of the reach lost to inundation from a project alternative. Acres lost to inundation are rounded to the nearest 0.1 acre.
[d]Outlet of proposed Tanner Ridge Tunnel downstream 2.27 miles to Sixth Water Creek (Three Forks).
[e]Sixth Water Creek downstream 2.54 miles to the Monks Hollow Dam site at Monks Hollow.

The 25 and 32 cfs enhancement flows from Strawberry Reservoir would result in stream temperatures nearly identical to those occurring at the depth in the reservoir from which the water was drawn. This would be the same as historical baseline conditions (pre-1996); however, the frequency of occasions when the releases to upper Sixth Water Creek would be drawn from below the thermocline of Strawberry Reservoir throughout the summer would increase. When this occurs, June through September temperatures would average 45°F to 47°F, which is 14°F to 19°F colder than most years during historical baseline conditions (see Table C-10 [CUWCD 1998b]). These cooler temperatures should not impair trout reproduction and would be within brown trout's optimum growth range of 46°F and 63°F (EPA 1973). However, temperatures below 47°F could potentially trigger a "winter activity pattern" consisting of daytime concealment in cover and nighttime emergence. Typical winter concealment cover is interstitial spaces between and under cobbles and boulders. Should adequate cover be lacking in a given stream reach, the trout would leave the area in search of suitable cover (Meyer and Griffith 1997). The likely effect of sustained years of colder water temperatures would be a lower trout standing crop that could be as much as 45 percent lower than the 356 pounds per acre noted above (based on Binns HQI predictions).

During years when most of the Strawberry Reservoir releases would be from above the thermocline, June through September temperatures in Sixth Water Creek would average 61°F to 67°F. These temperatures would be no warmer than those occurring under baseline conditions and would not impact the trout population.

Under the Proposed Action, the effect of the annual tunnel shutdown for inspection and maintenance in late October could cause concern. During the 1-week duration of the shutdown of Syar Tunnel (which also feeds the Strawberry Tunnel through a lateral connection), flows in Sixth Water and Diamond Fork Creeks would revert to base flows plus the 5 cfs of seepage from Strawberry Tunnel. Because brown trout spawning occurs from late October into December, there would be a small risk that reducing the flows from 25 cfs to the 7 cfs base flow could expose spawning redds (depressions in the gravels containing trout eggs) and reduce the annual recruitment of young trout. Because most of the brown trout spawning occurs in November, a 1-week shutdown in October should not significantly impact the reproduction success of brown trout.

Additionally, once every 7 to 10 years, Syar Tunnel would be shut down for repair over a 4-week period in October and November. The timing and duration of this reduction of the CUPCA-mandated flows down to natural base flow plus 5 cfs of seepage is likely to expose brown trout spawning redds and significantly reduce reproductive success for that year. A reduced year-class size every 7 to 10 years would not significantly affect the predicted long-term brown trout standing crop.

3.6.6.3.2.2 Lower Sixth Water Creek. The Proposed Action would remove all irrigation flows from Sixth Water Creek below the existing Syar Tunnel. Additionally, minimum flows in this reach of 32 and 25 cfs (summer/winter schedule) are mandated by CUPCA (see Table 3.6-4). Replacing the large irrigation flows with these minimum flows would reduce bank erosion and turbidity and, based on the 1997 IFIM results, the new flow regime would increase the amount of available adult brown and cutthroat trout habitat (Addley 1997). Optimal levels of dissolved nutrients would be provided by the hypolimnetic waters of Strawberry Reservoir. Trout standing crop would increase from 72 pounds per acre to an estimated 296 pounds per acre (see Table 3.6-5).

However, two operational conditions could reduce this estimated increase in trout biomass. As noted above for upper Sixth Water Creek, should Strawberry Reservoir releases be from below the reservoir's thermocline throughout the summer, June through September water temperatures could average 45°F to 49°F (CUWCD 1998b). The potential of trout adopting winter activity patterns when temperatures are below 47°F could reduce the predicted trout biomass by 45 percent. The other potential for reducing the estimated increase would be the effect on brown trout spawning success when the Syar Tunnel would be shut down for repair in November every 7 to 10 years. This would not, however, affect the long-term production of trout standing crop.

3.6.6.3.2.3 Diamond Fork Creek Below Three Forks. The reach of Diamond Fork Creek between Sixth Water Creek and Monks Hollow would also benefit from the elimination of irrigation flows and the CUPCA-mandated

32 cfs and 25 cfs minimum flows exiting Sixth Water Creek (see Table 3.6-4). The 1997 IFIM results show the Proposed Action flow regime would result in a 283 percent increase in adult brown trout habitat (Addley 1997). Juvenile brown trout habitat would increase 83 percent, while fry habitat would decline 44 percent. Neither the baseline nor Proposed Action flows would create brown trout spawning habitat in this reach. It is estimated that the trout standing crop in this reach would increase from the present estimate of 72 pounds per acre to 247 pounds per acre (see Table 3.6-5).

When Strawberry Reservoir releases are from above the thermocline, average temperatures of 61°F to 69°F would occur from June through September (CUWCD 1998b). These temperatures would be similar to baseline conditions and would not adversely affect the trout population. Years of below thermocline releases would result in June through August temperatures of 53°F to 55°F, which would be within the optimum range for brown trout. The effect of the annual tunnel shutdown on brown trout spawning success and standing crop would be the same as discussed in Section 3.6.6.3.2.1.

3.6.6.3.2.4 Diamond Fork Creek Below Monks Hollow. The primary effects of the Proposed Action on Diamond Fork Creek fisheries are related to the following changes from the baseline conditions: 1) CUPCA-mandated minimum flows of 80 cfs and 60 cfs; 2) an increased frequency of Strawberry Reservoir water being released from below the thermocline with an associated change in temperatures; and 3) a change in erosion, sediment load, and sedimentation as a result of the reduced flow regime. The effects of these changes on the fisheries are discussed below. The effect of the annual shutdown of the Syar Tunnel on brown trout spawning success and standing crop would be the same as that described in Section 3.6.6.3.2.1. Further details on water quality and sedimentation conditions associated with the Proposed Action can be found in the *Hydrology and Water Resources Technical Report* (CUWCD 1998b).

The Proposed Action flow regime would restore Diamond Fork Creek flows to a more natural pattern of peak runoff in mid-May with a subsequent gradual reduction in flows until the summer minimum flow of 80 cfs were reached (see Table 3.6-6). The 1997 IFIM study shows that adult brown and cutthroat trout habitat from Monks Hollow to the Spanish Fork River is maximized by flows in the range of 60 to 90 cfs and would create a 311 percent increase in adult trout habitat over the baseline conditions in Segments 1 and 2 and a 385 percent increase over baseline in Segment 3 (Addley 1997). Spawning habitat would increase 259 percent over baseline in Segments 1 and 2 and increase 61 percent over baseline in Segment 3. It is estimated that the trout standing crops would increase from 201 to 253 percent over baseline conditions for the three segments of this reach (see Table 3.6-7). Nutrient concentrations at optimal levels would continue to be provided by the hypolimnetic waters of Strawberry Reservoir.

Average June through September temperatures in this reach would be 49°F to 50°F when releases are from below the thermocline and 61°F to 67°F when from above the thermocline (CUWCD 1998b). Most of these temperatures would be within brown trout's optimum growth range of 46°F and 63°F (EPA 1973) and the colder temperatures would be sufficiently high that triggering a winter activity pattern would not be a concern. The maximum temperature would be about 0.5°F higher than the baseline conditions and would not adversely affect the trout population.

The lower summer flows and more stable base flow that would occur in both Sixth Water Creek and Diamond Fork Creek would result in less bank erosion and a lower sediment load entering Diamond Fork Creek. Fine sediments would generally be carried through to the Spanish Fork River. The Proposed Action also would have the flexibility to periodically provide additional spring peak flows if needed to maintain the channel and clean gravels of excess fines.

Table 3.6-6
Comparison of Mean Monthly Flows Used in the Binns HQI Analysis for Diamond Fork Creek Below Monks Hollow and for the Upper Spanish Fork River (cfs)

Project Alternative by Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Diamond Fork Creek Below Monks Hollow[a]												
Baseline	39	16	14	12	14	18	67	179	271	293	207	120
Proposed Action and MCAPW-DFT Alternative	60	60	60	60	60	60	88	144	128	106	80	80
MCAP, MCAPW, MCATC, MCAT Alternatives	60	60	60	60	60	60	60	81	130	194	81	80
No Action Alternative	60	60	60	60	60	60	60	82	87	106	80	82
Upper Spanish Fork River[b]												
Baseline	93	70	68	67	82	113	246	463	404	363	282	178
Proposed Action	114	113	114	114	128	154	267	427	262	176	155	138
MCAPW-DFT Alternative	177	146	146	146	163	189	285	519	481	466	347	229
MCAP, MCATC Alternatives	115	114	114	114	128	154	239	365	263	264	156	139
MCAPW Alternative	147	114	114	115	128	157	282	514	478	467	346	228
MCAT Alternative	158	114	114	114	127	157	282	523	522	527	375	238
No Action Alternative	132	334	345	349	354	360	342	505	440	408	336	305

[a]Monks Hollow downstream 7 miles to Spanish Fork River.
[b]Confluence of Diamond Fork Creek downstream 4.2 miles to the Strawberry Diversion Dam.

3.6.6.3.2.5 Upper Spanish Fork River. Under the Proposed Action, flows in the Spanish Fork River between Diamond Fork Creek and the Strawberry Diversion would have a late fall and winter base flow approximately 45 cfs higher than the baseline conditions of 70 cfs (see Table 3.6-6). Spring-summer flows would peak in May and then gradually decline through the summer. June through August flows would be approximately 130 cfs to almost 200 cfs lower than the irrigation flows under baseline conditions. Suspended and bedload sediments would be less than baseline conditions because of less sediment input from Diamond Fork Creek and from a lessening of local stream bank erosion associated with lower summer flows in the Spanish Fork River.

June through September water temperatures would average 54°F to 56°F when Strawberry Reservoir releases are from below the thermocline and 61°F to 67°F when from above the thermocline (CUWCD 1998b). These temperatures would be very suitable for the river's brown trout population. The lower summer flows and a more stable seasonal flow regime would increase the trout standing crop from the existing 8 pounds per acre to an estimated 35 pounds per acre (see Table 3.6-7). The annual shutdown of the Syar Tunnel for inspection and/or repair would lower Spanish Fork River flows to its base level of 40 cfs. As discussed in Section 3.6.6.3.2.1, this fall-season drop in flow would not affect the long-term production of trout standing crop.

Table 3.6-7
Binns HQI Assessment for Diamond Fork Creek Below Monks Hollow and Upper Spanish Fork River

Project Alternative by Stream Reach	Average Width (ft)	Habitat Lost to Inundation (acres)	Lb/Acre	Lb/Reach[a]	Change from Baseline (lb/reach)
Diamond Fork Creek below Monks Hollow, Segment 1[b]					
Baseline	24	0	73	276	
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives	29	0	247	1,129	+853
Diamond Fork Creek below Monks Hollow, Segment 2[c]					
Baseline	35	0	127	1,185	
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives	37	0	382	3,769	+2,584
Diamond Fork Creek below Monks Hollow, Segment 3[d]					
Baseline	32	0	70	950	
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives	45	0	247	4,715	+3,765
Upper Spanish Fork River[e]					
Baseline	50	0	8	204	
Proposed Action and MCAP and MCATC Alternatives	52	0	35	927	+723
MCAPW-DFT, MCAPW, and MCAT Alternatives	56	0	28	798	+594
No Action Alternative	69	0	9	316	+112

[a]The lb/reach values for the Proposed Action and alternatives include the trout biomass reduction resulting from riverine habitat loss to inundation.
[b]Segment 1 is from Monks Hollow downstream 1.3 miles to just above the Diamond Fork Campground.
[c]Segment 2 is from just above the Diamond Fork Campground downstream 2.2 miles to Brimhall Canyon.
[d]Segment 3 is from Brimhall Canyon downstream 3.5 miles to its confluence with the Spanish Fork River.
[e]The mouth of Diamond Fork Creek downstream 4.2 miles to the Strawberry Diversion Dam.

3.6.6.3.2.6 ***Lower Spanish Fork River.*** Under baseline conditions, the first 1.6 miles of the Spanish Fork River below the Strawberry Diversion Dam to the East Bench Diversion is mostly dry during the winter season because flows are diverted into the power canal and are returned to the river at the powerhouse just above the Mill Race Canal diversion (see Table 3.6-8). This lack of year-round flow results in no trout standing crop in this section. The 2.8 miles of river below the East Bench Diversion to the powerhouse presently receives 3 to 5 cfs of spring seepage and supports 5 pounds per acre of trout. The Proposed Action would provide year-round flows in both of these sections (see Table 3.6-8) and create trout standing crops of 35 pounds per acre and 24 pounds per acre in the sections above and below the East Bench diversion, respectively (see Table 3.6-9).

Table 3.6-8
Lower Spanish Fork River Mean Monthly Flows (cfs)

Project Alternative by Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Strawberry Diversion to East Bench Diversion												
Baseline	5	0	0	0	0	0	25	99	54	42	32	17
Proposed Action	44	40	42	43	41	38	47	125	95	88	52	47
MCAPW-DFT Alternative	84	72	74	75	76	71	52	141	120	145	72	54
MCAP, MCATC, MCAT, and MCAPW Alternatives	51	41	42	43	41	40	49	136	111	129	67	49
No Action Alternative	5	0	0	0	0	0	26	130	66	49	38	24
East Bench Diversion to Mill Race Canal*												
Baseline	0	0	0	0	0	0	17	50	1	0	0	0
Proposed Action	35	40	42	43	41	37	38	74	33	26	14	24
MCAPW-DFT Alternative	75	72	74	75	76	71	44	90	58	83	34	31
MCAP, MCATC, MCAT, and MCAPW Alternatives	41	41	42	43	41	40	41	85	49	67	28	25
No Action Alternative	0	0	0	0	0	0	17	80	10	3	4	5
Near Lake Shore												
Baseline	30	67	77	79	98	129	199	138	22	3	3	5
Proposed Action and MCAPW-DFT Alternative	93	132	143	146	166	193	228	214	40	16	10	30
MCAP, MCATC, MCAT, and MCAPW Alternative	71	169	119	122	140	169	223	162	39	16	10	30
No Action Alternative	58	328	349	357	369	372	283	155	23	3	5	112

*These flows do not include the 5 cfs of spring inflows.

Below the Mill Race Canal diversion are 15.6 miles of the Spanish Fork River that contain numerous agricultural diversions. Flows for this lowermost section of the river are reported for the point immediately downstream of the Lake Shore diversion. Baseline flows that drop to 3 cfs in late summer render most of this section marginal for trout. The Proposed Action would increase flows during all months, but August flows would average 10 cfs (see Table 3.6-8); during wet and dry water years, August flows would be 4 cfs and 2 cfs, respectively. Flows and temperatures would continue to limit a trout fishery in this section, but native non-game fish would benefit from the Proposed Action flow regime.

3.6.6.3.2.7 Salt Creek. During the irrigation season (mid-April to mid-October), the proposed Salt Creek facilities would divert peak flows from the Salt Creek Ditch at the diversion structure and incorporate it into the SFN System for delivery to agricultural fields. To maintain the existing wild brown trout fishery and riparian vegetation in this ditch, which bisects Nephi, natural flows (flows immediately upstream of the proposed diversion structure) of 16 cfs or less would be left in the ditch from April through September. Through October, this bypass flow would be reduced to natural flows of 8 cfs or less.

Table 3.6-9
Binns HQI Assessment for Lower Spanish Fork River

Project Alternative by Stream Reach	Average Width (ft)	Habitat Lost to Inundation (acres)	Lb/Acre	Lb/Reach	Change from Baseline (lb/reach)
Lower Spanish Fork River Above East Bench Diversion[a]					
Baseline	0	0	0	0	
Proposed Action and MCAP, MCAPW, MCATC, and MCAT Alternatives	43	0	35	292	+292
MCAPW-DFT Alternative	47	0	29	264	+264
No Action Alternative	No change from baseline conditions				
Lower Spanish Fork River Below East Bench Diversion[b]					
Baseline	10	0	5	17	
Proposed Action and MCAP, MCAPW, MCATC, and MCAT Alternatives	32	0	24	261	+244
MCAPW-DFT Alternative	38	0	29	374	+357
No Action Alternative	No change from baseline conditions				

[a]From the Strawberry Diversion downstream 1.6 miles to the East Bench Diversion.
[b]Downstream of the East Bench Diversion 2.8 miles to the powerhouse and Mill Race Canal Diversion. The lowermost 15.6 miles of the Spanish Fork River to Utah Lake was not included in the Binns analysis because it is too warm to support a viable trout fishery.

Although the operation of the Salt Creek facilities cannot guarantee minimum flows above that of the natural flow upstream of the proposed diversion structure, the existing lower 60 percent of the hydrograph of flows in the Salt Creek Ditch would be unchanged from baseline conditions. A Binns HQI analysis of these Proposed Action flow conditions indicates there would be no impact to the creek's trout numbers or that of other aquatic biota.

The small irrigation ditch adjacent to the railroad tracks on the west side of Nephi would no longer receive Salt Creek Ditch water because the Nephi pumping plant would preclude the need for the ditch as part of the irrigation distribution system. The ditch runs 800 feet north and south of Salt Creek Ditch before being diverted into smaller delivery systems and provides trout habitat in this 1,600 feet of channel. The irrigation ditch trout habitat lost under the Proposed Action would amount to 7 percent of the total trout habitat, or an annual loss of 8 pounds of trout. According to the significance criteria stated in Section 3.6.6.1, a loss of this magnitude would be significant.

3.6.6.3.2.8 West Creek. The existing fisheries of West Creek would not be adversely affected by the increased salinity (11 percent over baseline) and turbidity, but would benefit from improved habitat conditions from higher flows (55 percent greater) during summer.

3.6.6.3.2.9 Currant Creek, Burraston Ponds, and Mona Reservoir. According to the water resources analysis in Section 3.2.6.3.2.1, the Proposed Action would increase the outflow of springs feeding upper Currant Creek and Burraston Ponds by 55 to 60 percent and would result in an 11 percent increase in TDS. This increase in salinity is not considered significant, as it would not cause an exceedence of the fisheries significance criterion

for TDS (2,000 to 5,000 ppm). The increased summer flow is likely to benefit these fisheries by increasing the quantity of wetted habitat in Currant Creek during the summer months when portions of the creek are dry.

The primary concern for trace element exposure to aquatic biota under baseline conditions in the upper Currant Creek drainage is exposure to copper and selenium in aquatic invertebrates and fish. Both selenium and copper are elevated in some upper Currant Creek sediment samples as compared to assessment criteria. It is not expected that the Proposed Action would change the effects of the current baseline exposure to selenium or other trace metals significantly and would not cause a biologically significant increase in mean concentrations of any of these trace elements in fish or invertebrates.

No adverse impacts to fisheries of Mona Reservoir would result from the Proposed Action's effects on salinity. The salinity levels associated with the Proposed Action are less than baseline conditions and are well below the lowest fishery significance criterion threshold of 2,000 ppm TDS. These salinity levels would have no adverse effect on the coldwater and warmwater fisheries of the reservoir. Although greater seasonal fluctuations in water level would occur with the Proposed Action, there would be fewer occasions of the reservoir being drained to the elevation of the "dead storage pool," where deteriorating water quality conditions (i.e., temperature, dissolved oxygen, and turbidity) could result in fish kills.

Mona Reservoir's water elevation during July and August as a result of the Proposed Action would be 1.6 to 1.7 feet lower than under baseline conditions. This may adversely impact the yellow perch fishery of the reservoir. Young-of-the-year (YOY) yellow perch need adequate cover habitat throughout the summer. The decrease in water level from baseline conditions during the 2-month period could potentially decrease cover for yellow perch YOY and reduce recruitment for the adult year classes of this species. Additionally, these low water conditions crowd the fish into the pool in front of the unscreened outlet structure on the dam, and YOY fish loss through the outlet to Currant Creek would increase. Should this result in smaller adult year classes, it could lower the population's biomass and angler harvest. These losses would be offset by the longer-term viability of the population as a result of the reduction in the frequency that the reservoir would be drained. During the period of record, baseline conditions resulted in Mona Reservoir being lowered to its "dead pool" elevation (4,862 feet) in 11 of the 44 years examined. The Proposed Action would result in the dead pool elevation occurring only once in a 44-year period. The magnitude and significance of a reduction in numbers of yellow perch YOY are difficult to assess, but should be offset by the benefit of the reservoir being drained less often to the elevation of the dead storage pool where deteriorating water quality conditions (i.e., temperature, dissolved oxygen, and turbidity) typically result in fish kills.

3.6.6.3.3 Mitigation. Water quality commitments for the impact area of influence (including temperature regulation) previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) would remain in effect (see Section 3.3.6.6.3 for more detail). Annual monitoring of the Diamond Fork Creek channel and trout spawning gravels would determine if additional May flows are needed periodically to maintain the channel and clean the gravels of deposited fines.

3.6.6.3.4 Unavoidable Adverse Impacts. The Proposed Action would result in the following unavoidable adverse impacts to aquatic resources. Every 7 years, the Syar Tunnel shutdown for repairs would impact brown trout spawning success in Sixth Water and Diamond Fork Creeks, with a lesser impact to spawning success in the Spanish Fork River. Years that summer water releases from Strawberry Reservoir would occur from below the thermocline would result in cold water temperatures that might trigger a winter activity pattern for trout in Sixth Water Creek and potentially lower the predicted trout standing crop for this stream. During many years, peak flows would not be sufficient to clean the trout spawning gravels of fines. The removal of year-round Salt Creek Ditch flows to the irrigation canals on the west side of Nephi would reduce the trout standing crop by 7 percent. July and August water surface elevations in Mona Reservoir would be lower than existing conditions and result in reduced cover for and numbers of yellow perch YOY.

3.6.6.4 MCAPW-DFT Alternative

The MCAPW-DFT Alternative is very similar to the Proposed Action in that the "Diamond Fork Tunnel Alternative" (two tunnels, two siphons, and a pipeline) would be constructed to connect the Sixth Water Aqueduct to the Diamond Fork Pipeline. The physical facilities of this alternative would be nearly the same as those described for the Proposed Action; however, the Main Conveyance Aqueduct would not replace the High Line Canal. Instead, it would parallel the High Line Canal in the Salem and Payson areas. Operationally, the MCAPW-DFT Alternative would differ from the Proposed Action in that the Main Conveyance Aqueduct would not convey SVP water. The SVP water carried through the "Diamond Fork Tunnel Alternative" and Diamond Fork Pipeline would be discharged near the mouth of Diamond Fork Creek. Similar to baseline conditions, SVP water would be conveyed by the Spanish Fork River to the Strawberry Diversion Dam.

The following sections describe the construction- and operation-related impacts resulting from the MCAPW-DFT Alternative. These impacts are summarized in table format in Section 3.6.6.11.

3.6.6.4.1 Construction Impacts. Procedures and impacts associated with the "Diamond Fork Tunnel Alternative," and the Main Conveyance Aqueduct's crossing of the Spanish Fork River, would be the same as those identified under the Proposed Action. Construction of the turnout that would be used for discharging SVP water into Diamond Fork Creek near its mouth would adhere to the construction procedures discussed in Chapter 1 for the purpose of preventing excessive loading of sediment and the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, and paints.

3.6.6.4.2 Operation Impacts. Flows in Sixth Water Creek and Diamond Fork Creek and their resulting benefits to fisheries would be the same as described for the Proposed Action (see Tables 3.6-4 through 3.6-7).

The MCAPW-DFT Alternative would differ from the Proposed Action in that upper Spanish Fork River flows would be higher. Base flows would be approximately twice those of baseline conditions, and irrigation season flows would be roughly 100 cfs higher than occurs presently (see Table 3.6-6). The increase in current velocities, bank erosion, and turbidity would be partially offset by the higher and more consistent base flow. The MCAPW-DFT Alternative would increase the trout standing crop from 8 pounds per acre to 28 pounds per acre (see Table 3.6-7). Flows in the lower Spanish Fork River between the Strawberry Diversion and the Mill Race Canal diversion would become year-round and range from 54 cfs to 141 cfs in the section above the East Bench Diversion and 31 cfs to 90 cfs below the East Bench Diversion (see Table 3.6-8). These year-round flows would increase the trout standing crop of these two stream sections from zero and 5 pounds per acre to 29 pounds per acre through both sections (see Table 3.6-9). The MCAPW-DFT Alternative flows in the lower Spanish Fork River at Lake Shore would be the same as those that would result from the Proposed Action.

Because water delivery and return flows to the lower Spanish Fork River, valley streams, Burraston Ponds, and Mona Reservoir under the MCAPW-DFT Alternative would be the same as those associated with the Proposed Action, the potential impacts and benefits to the aquatic biota and habitat of these waters would be the same as those discussed for the Proposed Action.

3.6.6.4.3 Mitigation. The proposed mitigation measures would be the same as those identified for the Proposed Action.

3.6.6.4.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts for the MCAPW-DFT Alternative would be the same as described for the Proposed Action.

3.6.6.5 MCAP Alternative

The MCAP Alternative differs primarily from the Proposed Action in that Strawberry Reservoir water would continue to enter the Diamond Fork drainage at the outlet of the Sixth Water Aqueduct and require the construction of Monks Hollow Dam on Diamond Fork Creek to store and re-regulate this water before it enters the Diamond Fork Pipeline or the downstream creek channel.

3.6.6.5.1 Construction Impacts. MCAP Alternative facilities to be constructed include Monks Hollow Dam and Reservoir and the 43.6-mile Main Conveyance Aqueduct. Construction impacts associated with the Main Conveyance Aqueduct would be the same as those described for the Proposed Action. Construction of Monks Hollow Dam and Reservoir would inundate 2.54 miles of Diamond Fork Creek below Three Forks (7.1 acres of riverine habitat); 1,003 linear feet of Diamond Fork Creek above Three Forks (0.3 acre of riverine habitat); 1,584 linear feet of lower Sixth Water Creek (0.8 acre of riverine habitat); and 581 linear feet of Cottonwood Creek (0.08 acre of riverine habitat). The loss of annual riverine trout production for all four stream sections inundated by Monks Hollow Dam would total 610 pounds (see Table 3.6-5).

Dam construction would create large quantities of disturbed soil, portions of which could potentially enter Diamond Fork Creek and degrade downstream aquatic habitat through sedimentation. Adhering to best management practices for construction procedures would prevent excessive input of sediment from these sources of disturbed soil as well as the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures would reduce the potential for these types of construction-related fishery impacts to not significant.

3.6.6.5.2 Operation Impacts

3.6.6.5.2.1 Upper Sixth Water Creek. Impacts to upper Sixth Water Creek from the MCAP Alternative would be the same as those described for the Proposed Action.

3.6.6.5.2.2 Lower Sixth Water Creek. Flows in lower Sixth Water Creek under the MCAP Alternative would be substantially larger than historical baseline flows and would increase channel and stream bank scouring and turbidity (see Table 3.6-4). Average monthly flows of 272 to 632 cfs from May through September would more than double the unnaturally high flows that occur under baseline conditions. However, base flows would be increased to approximately 60 cfs; the IFIM study shows this flow would increase adult brown trout habitat 18 percent over baseline conditions. The Binns HQI analysis estimates the trout population of this reach would increase from 72 pounds per acre to an estimated 99 pounds per acre (see Table 3.6-5). This reach would experience the same increased frequency of 45°F to 47°F temperatures described for Sixth Water Creek.

3.6.6.5.2.3 Diamond Fork Creek Below Monks Hollow. Although increased flows and associated scouring of lower Sixth Water Creek would increase the sediment load entering Diamond Fork Creek, Monks Hollow Dam would capture 92 percent of this material. The portion of suspended sediments carried past the dam would be mostly fine material that should carry through the system with less deposition than would occur with the Proposed Action. With lowered flows (see Table 3.6-6), the Diamond Fork Creek channel below Monks Hollow Dam would stabilize as it experienced decreased bank erosion. This improvement in channel and stream bank stability would benefit the population of trout and other fishes by increasing the quality and quantity of suitable habitat. Instream flow variation in response to irrigation water demand would be substantially reduced as this variation would typically occur within the pipeline.

When irrigation releases are from above the thermocline, average monthly temperatures for the MCAP Alternative would be approximately 7°F to 18°F cooler than under baseline conditions. No information is available for baseline temperatures associated with irrigation releases from below the thermocline because it was an infrequent event during the period of record. Flow releases from below the thermocline under the MCAP Alternative would

result in Diamond Fork Creek average temperatures for June through September ranging from 46°F to 48°F. Strawberry Reservoir releases from above the thermocline would create average temperatures from June through December of 63°F to 69°F.

The lowest temperature of 46°F in June would not affect brown trout egg or larvae development (Hilton 1995), because brown trout spawn during October through December and the young brown trout in Diamond Fork Creek are believed to emerge from the spawning gravels in April (Hilton 1995; Sakaguchi 1995). The estimated temperature ranges for the 4-month period of summer are within brown trout's optimum growth range of 46°F to 63°F (EPA 1973). However, juvenile and adult brown and rainbow trout have been observed exhibiting winter behavioral patterns when temperatures drop below 47°F (Campbell and Neuner 1985; Richie and Griffith 1993; Meyer and Griffith 1997).

Rainbow and cutthroat trout form a minor component of the Diamond Fork Creek trout fishery. They are spring spawners that likely spawn in March or April. With water releases from below the thermocline, May temperatures could occasionally cause localized trout egg loss from excessively low temperatures. Although low temperatures would delay young trout emergence from their spawning gravels by 2 weeks, this would not be a significant impact (Hilton 1995). The prolonged colder water temperatures during the summer months would also result in a slower growth rate for trout than occurs under baseline conditions of irrigation releases from above the thermocline.

Because of the higher base flows provided by the CUPCA-mandated minimum flows, the MCAP Alternative would result in a 300 percent increase in wild trout biomass in Diamond Fork Creek over baseline conditions (see Table 3.6-7). The MCAP Alternative trout standing crop for this reach would be 9,613 pounds.

3.6.6.5.2.4 Upper Spanish Fork River. The MCAP Alternative would have the same effects on water temperature and the fisheries as described for the Proposed Action (see Table 3.6-7). However, the Diamond Fork Creek sediment load entering the upper Spanish Fork River would be reduced by 45 percent because Monks Hollow Dam would capture most of the upstream sediment. This reduction in sediment loading would be beneficial to the fisheries of the upper Spanish Fork River.

3.6.6.5.2.5 Lower Spanish Fork River. The MCAP Alternative would have the same effects on the fisheries of the Spanish Fork River between the Strawberry Diversion Dam and Utah Lake as described for the Proposed Action (see Tables 3.6-8 and 3.6-9).

3.6.6.5.2.6 East Juab County and Utah County Valley Streams. The MCAP Alternative would have the same effects on the water quality and fisheries of Burraston Ponds, Mona Reservoir, and Salt, West, upper Currant, lower Currant, Spring, and Beer Creeks, as described for the Proposed Action.

3.6.6.5.3 Mitigation. Water quality commitments for the impact area of influence (including temperature regulation) previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) would remain in effect (see Section 3.3.6.6.3 for more detail).

3.6.6.5.4 Unavoidable Adverse Impacts. The MCAP Alternative would result in the same unavoidable adverse impacts as described for the Proposed Action, with the following additional impacts. Approximately 8.3 acres of riverine habitat presently producing 610 pounds of trout annually would be lost to inundation by Monks Hollow Dam and Reservoir. Years that summer water releases from Strawberry Reservoir are from below the thermocline would result in cold water temperatures that might trigger a winter activity pattern for trout in both Sixth Water Creek and Diamond Fork Creek below Monks Hollow, potentially lowering the predicted trout standing crop for these streams.

3.6.6.6 MCAPW Alternative

The MCAPW Alternative is similar to the MCAP Alternative except that SVP water would be discharged from the terminus of the Diamond Fork Pipeline near the mouth of Diamond Fork Creek. This SVP water would then flow through 4.2 miles of the upper Spanish Fork River to the Strawberry Diversion Dam.

3.6.6.6.1 Construction Impacts. Procedures and impacts associated with pipeline and facility construction, and the Main Conveyance Aqueduct crossing of the Spanish Fork River, would be the same as those identified under the Proposed Action. Construction of the turnout for discharging SVP water into Diamond Fork Creek near its mouth would adhere to the construction procedures discussed in Chapter 1 for the purpose of preventing excessive loading of sediment and the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, and paints.

3.6.6.6.2 Operation Impacts. The MCAPW Alternative operational impacts to the fisheries of Sixth Water Creek and Diamond Fork Creek are the same as those described for the MCAP Alternative. From November through March, the MCAPW Alternative base flows in the upper Spanish Fork River would be nearly identical to those of the Proposed Action (see Table 3.6-6). However, irrigation season flows would be up to 100 cfs higher in some months than those under baseline conditions. The effect of the MCAPW Alternative on the fisheries of the upper Spanish Fork River would be the same as described for the MCAPW-DFT Alternative; impacts to the lower Spanish Fork River fisheries would be the same as those described for the Proposed Action.

Because water delivery and return flows to the lower Spanish River, valley streams, Burraston Ponds, and Mona Reservoir under the MCAPW Alternative would be the same as those associated with the Proposed Action, the potential impacts and benefits to the aquatic biota and habitat of these waters would be the same as those discussed for the Proposed Action.

3.6.6.6.3 Mitigation. The proposed mitigation measures would be the same as those identified for the MCAP Alternative.

3.6.6.6.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts resulting from the MCAPW Alternative would be the same as those identified for the MCAP Alternative.

3.6.6.7 MCATC Alternative

The MCATC Alternative is similar to the MCAP Alternative; however, the Main Conveyance Aqueduct would cross the Spanish Fork River at a different location and follow a different alignment in southern Utah County.

3.6.6.7.1 Construction Impacts. The MCATC Alternative would cross the upper Spanish Fork River in the vicinity of Covered Bridge Road, then proceed up Pole Canyon to the Loafer Mountain Tunnel inlet. The pipeline and siphon crossings of the upper Spanish Fork River, Peteetneet Creek, and Summit Creek would be constructed during low-flow periods using coffer dams, where necessary. Adhering to best management practices for construction procedures (described in Chapter 1) would prevent excessive input of sediment from these sources of disturbed soil as well as the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures would reduce the potential for these types of construction-related fishery impacts to insignificant.

3.6.6.7.2 Operation Impacts. The flows, temperature, and water quality in Sixth Water Creek, all portions of Diamond Fork Creek, and the upper Spanish Fork River would be the same as those described for the MCAP Alternative and would have a similar effect on the fisheries of those streams. The changes to water temperature and turbidity in the lower Spanish Fork River from the Strawberry Diversion Dam to Utah Lake would also be the same as those described for the MCAP Alternative. Because of their similarity to the Proposed Action flows,

the effect of the MCATC Alternative flows on the fisheries in the lower Spanish Fork River would be the same as that described for the Proposed Action.

Potential MCATC Alternative impacts on valley streams, Burraston Ponds, and Mona Reservoir would be similar to those discussed for the Proposed Action.

3.6.6.7.3 Mitigation. The proposed mitigation measures would be the same as those identified for the MCAP Alternative.

3.6.6.7.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts resulting from the MCATC Alternative would be the same as those identified for the MCAP Alternative.

3.6.6.8 MCAT Alternative

The MCAT Alternative is similar to the MCATC Alternative; however, the Main Conveyance Aqueduct would not convey SVP water. For this reason, upper and lower Spanish Fork River flows for the MCAT Alternative would be the same as those described for the MCAPW Alternative.

3.6.6.8.1 Construction Impacts. Construction impacts would be the same as those identified under the MCATC Alternative.

3.6.6.8.2 Operation Impacts. The flows, temperature, and water quality in Sixth Water Creek and all portions of Diamond Fork Creek would be the same as those described for the MCAP Alternative and would have similar effects on the fisheries of those streams (see Tables 3.6-4 through 3.6-7). Impacts to the upper and lower Spanish Fork River fisheries would be the same as those described for the MCAPW Alternative.

Because water delivery to the valley streams, Burraston Ponds, and Mona Reservoir under the MCAT Alternative would be the same as that described for the Proposed Action, the potential impacts and benefits to the aquatic habitat and biota of these waters are the same as those discussed for the Proposed Action.

3.6.6.8.3 Mitigation. The proposed mitigation measures would be the same as those identified for the MCAP Alternative.

3.6.6.8.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts resulting from the MCAT Alternative would be the same as those identified for the MCAP Alternative.

3.6.6.9 No Action Alternative

The SFN System would not be constructed under the No Action Alternative. However, the diversion of water into the existing Diamond Fork Pipeline would require the construction of Three Forks Dam and Reservoir at the junction of Diamond Fork, Sixth Water, and Cottonwood Creeks. The existing Diamond Fork Pipeline would be extended upstream 2.5 miles to connect with Three Forks Dam.

3.6.6.9.1 Construction Impacts. Facilities that would be constructed for the No Action Alternative include Three Forks Dam and Reservoir plus the 2.5-mile upstream extension of the Diamond Fork Pipeline. Construction of Three Forks Dam and Reservoir would inundate 1,690 linear feet of Diamond Fork Creek above Three Forks (0.5 acre of riverine habitat); 2,006 linear feet of lower Sixth Water Creek (1.01 acres of riverine habitat); and 1,003 linear feet of Cottonwood Creek (0.14 acre of riverine habitat). The loss of annual riverine trout standing crop for all three stream sections inundated by Three Forks Reservoir would total 142 pounds at existing levels of trout production (see Table 3.6-5).

Construction of the dam and pipeline extension would disturb soil, portions of which could potentially enter Diamond Fork Creek and degrade downstream aquatic habitat through sedimentation. Adhering to best management practices for construction procedures would prevent excessive input of sediment from these sources of disturbed soil as well as the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures would reduce the potential for these types of construction-related fishery impacts to insignificant.

3.6.6.9.2 Operation Impacts. No SFN System facilities would be constructed under the No Action Alternative and no irrigation water would be delivered to eastern Juab County. Therefore, only waterways in southern Utah County (i.e., Diamond Fork Creek, the Spanish Fork River, Spring Creek, Beer Creek, and Benjamin Slough) would be affected under this alternative's operations.

3.6.6.9.2.1 Sixth Water Creek. Upper Sixth Water Creek flows and fishery impacts would be the same as those described for the Proposed Action. Flows in lower Sixth Water Creek would increase substantially during all months. With the exception of mean monthly flows between 55 cfs and 104 cfs in October, April, and May, flows for the remaining months are typically between 200 cfs and 300 cfs. Because of the increased base flow, the trout standing crop in lower Sixth Water Creek would increase from 72 pounds per acre to 112 pounds per acre (see Table 3.6-5).

3.6.6.9.2.2 Diamond Fork Creek from Three Forks to Monks Hollow. Flows in Diamond Fork Creek from Three Forks to Monks Hollow would vary only slightly from the 60 and 80 cfs mandated by CUPCA and would have a mean peak flow of 144 cfs in May (see Table 3.6-4). The 1997 IFIM study shows that adult brown trout and cutthroat trout habitat would maximize at flows of 80 cfs and 50 cfs, respectively, in this reach (Addley 1997). When Strawberry Reservoir releases are from below the thermocline, the June through September average monthly temperatures in this reach would be 47°F to 49°F and from 63°F to 69°F when releases are from above the thermocline. These temperatures would be suitable for brown and cutthroat trout. With stabilized flows and enhanced winter flows, the trout standing crop would increase from 72 pounds per acre to 192 pounds per acre for this reach.

3.6.6.9.2.3 Diamond Fork Creek from Monks Hollow to the Spanish Fork River. The No Action Alternative would result in Diamond Fork Creek flows stabilizing around the CUPCA-mandated minimum flows. A peak flow of 144 cfs would occur in May, and for the remainder of the year, the flows would range from about 60 to 80 cfs, depending on the season. When Strawberry Reservoir releases are from below the thermocline, the June through September average monthly temperatures in this reach would be 47°F to 49°F and from 63°F to 69°F when releases are from above the thermocline. The IFIM results show adult brown trout and cutthroat trout habitat would maximize at flows of 90 cfs and 60 cfs, respectively, in this reach (Addley 1997). The 8 miles of Diamond Fork Creek to the Spanish Fork River would benefit from the No Action Alternative's lower and more stabilized flow regime and yield the same trout standing crop increase as described for the Proposed Action (see Table 3.6-7).

The No Action Alternative is similar to the Proposed Action in that the average flow regime would be insufficient to flush sediments and maintain the channel from riparian encroachment. This could result in a long-term loss of trout spawning and juvenile habitat to sedimentation and riparian encroachment, particularly in the Segment 3 reach of Diamond Fork Creek below Brimhall Canyon. Flushing flows in excess of the 300 to 400 cfs needed for channel and spawning gravel maintenance would occur periodically as part of the natural pattern of wet years and high runoff events. Three Forks Dam, because of its relatively small capacity, would be only a minor impediment to peak flows from the upstream drainage.

3.6.6.9.2.4 Upper Spanish Fork River. Under the No Action Alternative, the greatly increased Diamond Fork Creek inflow to the upper Spanish Fork River would cause an increase in scouring of stream banks along the Spanish Fork River, resulting in increased turbidity and sedimentation. This habitat degradation would be partially

offset by the relatively stable flow regime and high base flow (see Table 3.6-6). Trout habitat would be concentrated along the rough edges of the channel as occurs presently. When Strawberry Reservoir releases are from below the thermocline, the June through September average monthly temperatures in this reach would be 52°F to 53°F and from 62°F to 69°F when releases are from above the thermocline. The No Action Alternative would increase the trout standing crop of this reach from the existing 8 pounds per acre to an estimated 9 pounds per acre (see Table 3.6-7).

3.6.6.9.2.5 Lower Spanish Fork River. Although the No Action Alternative would result in a larger volume of water flowing through the lower Spanish Fork River to Utah Lake than occurs under baseline conditions, it would be similar to baseline conditions in that the fisheries of all sections would experience one or more months annually of dry or nearly dry conditions (see Table 3.6-8). For this reason, the fisheries standing crop would be the same as baseline conditions (see Table 3.6-9).

3.6.6.9.2.6 Spring Creek, Beer Creek, and Benjamin Slough. Lower Spring Creek, Beer Creek, and Benjamin Slough would experience a 10 to 11 percent flow increase (less for Spring Creek) and an approximately 3 percent reduction in salinity. There would be no significant change in overall water quality characteristics. The No Action Alternative would not have a significant impact to the fisheries of these creeks.

3.6.6.9.2.7 Salt Creek. The loss of 7 percent of the trout fishery as described for the Proposed Action would also occur under local development under the No Action Alternative.

3.6.6.9.3 Mitigation. Water quality commitments for the impact area of influence (including temperature regulation) previously made in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990) would remain in effect.

Annual monitoring of the Diamond Fork Creek channel and gravels below Monks Hollow would determine if additional May flows are needed periodically to maintain the channel and clean trout spawning gravels of deposited fines. Should additional peak flows be deemed necessary to supplement the natural runoff, the magnitude and duration of such releases from Strawberry Reservoir would be determined at that time.

3.6.6.9.4 Unavoidable Adverse Impacts. The No Action Alternative would result in the same unavoidable adverse impacts as described for the Proposed Action (Salt Creek Ditch impacts would occur as part of local development); however, impacts to Mona Reservoir would not occur. Additionally, approximately 1.65 acres of riverine habitat presently producing 142 pounds of trout annually would be lost to inundation by Three Forks Dam and Reservoir. Years that summer water releases from Strawberry Reservoir are from below the thermocline would result in cold water temperatures that might trigger a winter activity pattern for trout in both Sixth Water Creek and Diamond Fork Creek below Monks Hollow, potentially lowering the predicted trout standing crop for these streams.

3.6.6.10 Summary of Impacts

The Proposed Action would be significantly beneficial to trout populations in upper and lower Sixth Water Creek, Diamond Fork Creek, and the upper and lower Spanish Fork River as a result of a more stabilized flow regime, less erosion and turbidity, and suitable water temperatures. These conditions, combined with the optimal nutrient levels associated with the Strawberry Reservoir releases, would result in a 213 percent net increase over baseline conditions in wild trout standing crop throughout the impact area of influence. This gain in trout production could be reduced should hypolimnetic releases from Strawberry Reservoir create sustained periods of summer water temperatures of less than 47°F in Sixth Water Creek and cause trout to adopt a winter activity pattern. In most years, the Proposed Action flow regime would lack sufficiently high spring flows to flush fines from spawning gravel. Unless mitigated by periodic spring releases of 250 cfs to 400 cfs, trout reproduction success could eventually be reduced to levels having an adverse impact on the trout fisheries. The annual shutdown of Syar

Tunnel in October and/or November for inspection and maintenance also has the potential to reduce brown trout spawning success throughout Sixth Water and Diamond Fork Creeks. By limiting the annual shutdown to 1 week in October, there would be no significant impact on brown trout spawning. By restricting the 4-week shutdown for repairs to once every 7 years, brown trout spawning success for that year would be impacted, but this would not affect long-term trout standing crop. Non-game fish in Juab Valley streams within the impact area of influence would benefit from increased instream flows from groundwater.

The loss of 7 percent of the trout habitat in the Salt Creek Ditch and its irrigation canals would be a significant impact that is unavoidable. This impact would result from conveying most of the Salt Creek Ditch water via pipe, thereby removing year-round flow from the irrigation ditch.

The reduction in yellow perch YOY habitat in Mona Reservoir during summer months and limiting them to the pool near the outlet could ultimately reduce the number of adult yellow perch in the reservoir and significantly affect the sport fishery. This adverse impact would be offset by the benefit of a reduced frequency that the reservoir would be drained.

Impacts associated with the MCAPW-DFT Alternative would be nearly identical to those of the Proposed Action and would result in a 212 percent net increase in wild trout standing crop over baseline conditions.

The MCAP Alternative benefits trout populations in upper Sixth Water Creek, Diamond Fork Creek, and the upper and lower Spanish Fork River as a result of a more stabilized flow regime, less erosion and turbidity, and suitable water temperatures. This alternative would result in a 150 percent net increase over baseline conditions in wild trout standing crop throughout the impact area of influence. As described above for the Proposed Action, sustained periods of very cold water releases from Strawberry Reservoir could reduce the predicted trout gains in Sixth Water Creek, and the annual shutdown of the Syar Tunnel in October and/or November for inspection and maintenance has the potential to reduce brown trout spawning success throughout Sixth Water Creek. The lack of sufficiently high spring flushing flows could eventually impact trout reproduction in Diamond Fork Creek. Lower Sixth Water Creek would receive higher flows that would significantly reduce access by anglers. Monks Hollow Reservoir would inundate 7.4 acres of riverine habitat in Diamond Fork Creek and another 0.9 acre of riverine habitat in Cottonwood Creek and lower Sixth Water Creek. Benefits and adverse impacts to the fisheries of the Juab Valley streams within the impact area of influence would be the same as those described for the Proposed Action.

The MCAPW Alternative would yield a 148 percent net increase over baseline conditions in wild trout standing crop throughout the impact area of influence. Its adverse impacts and benefits to fisheries would be the same as those described above for the MCAP Alternative with the following exception: because of higher flows, trout standing crop in the upper Spanish Fork River would be 14 percent less than that produced by the MCAP Alternative.

MCATC Alternative beneficial and adverse impacts to fisheries would be the same as those described for the MCAP Alternative (i.e., 150 percent increase over baseline conditions). MCAT Alternative impacts and benefits would be identical to the MCAP Alternative except that, because of increased flows, the upper Spanish Fork River trout production would be 14 percent less than that of the MCAP Alternative. This alternative's net effect on wild trout standing crop within the entire area of influence would be a 148 percent increase over baseline conditions.

The beneficial impacts resulting from the No Action Alternative would include increased trout populations in upper Sixth Water Creek and Diamond Fork Creek. The No Action Alternative would yield a 174 percent net increase over baseline conditions in wild trout standing crop throughout the impact area of influence. High flows in lower Sixth Water Creek would limit angling access to October. As described above for the Proposed Action, sustained periods of very cold water releases from Strawberry Reservoir could reduce the predicted trout gains in Sixth Water Creek, and the lack of sufficiently high spring flushing flows could eventually impact trout reproduction

in Diamond Fork Creek. The annual shutdown of the Syar Tunnel in October and/or November for inspection and maintenance also has the potential to reduce brown trout spawning success throughout Sixth Water and Diamond Fork Creeks. High flows in the upper Spanish Fork River would degrade trout habitat, but this would be offset by the higher base flow. There would be no change to the limited trout fishery of the lower Spanish Fork River. Increased flows and lower salinity (compared to baseline conditions) would occur in Beer Creek and Benjamin Slough from increased groundwater. No other Juab Valley streams would be affected by the No Action Alternative.

A summary of impacts to aquatic resources that would result from the Proposed Action and the alternatives is provided in Table 3.6-10.

Table 3.6-10
Summary of Impacts on Aquatic Resources

Page 1 of 6

Feature	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Upper Sixth Water Creek	CUPCA-mandated flows would increase the baseline trout standing crop from 3,351 lb to 6,365 lb (a 90 percent increase over baseline)	Significant	None	Significant
	When Strawberry Reservoir releases are from below the thermocline, sustained summer temperatures of < 47°F could induce a winter activity pattern and lower predicted trout standing crop.	Significant	Monitor to determine the significance of this potential problem. If significant, increase temperature through destratification of reservoir outlet area or other means.	Not significant
	Annual October-November shutdown of Syar Tunnel for 4 weeks every 7 to 10 years could impair brown trout spawning success and lower predicted trout standing crop, but would not affect the long-term trout standing crop.	Not significant	None	Not significant
Lower Sixth Water Creek	The baseline trout standing crop of 691 lb would increase to 3,358 lb (a 386 percent increase over baseline)	Significant	None	Significant
	When Strawberry Reservoir releases are from below the thermocline, sustained summer temperatures of < 47°F could induce a winter activity pattern and lower predicted trout standing crop.	Significant	Monitor to determine significance of this potential problem. If significant, increase temperature by destratifying reservoir outlet area or other means.	Not significant

Table 3.6-10
Summary of Impacts on Aquatic Resources

Feature	Impact	Significance	Mitigation	Significance After Mitigation
	Annual October-November shutdown of Syar Tunnel for 4 weeks every 7 to 10 years could impair brown trout spawning success and lower predicted trout standing crop, but would not affect the long-term trout standing crop.	Not significant	None	Not significant
Diamond Fork Creek below Three Forks	The baseline trout standing crop of 510 lb would increase to 1,901 lb (a 273 percent increase over baseline)	Significant	None	Significant
Diamond Fork Creek below Monks Hollow	The baseline trout standing crop of 2,411 lb would increase to 9,613 lb (a 299 percent increase over baseline)	Significant	None	Significant
	A lack of adequate flushing flows would allow fines to accumulate in spawning gravels and impair trout reproduction success.	Significant	Monitor spawning gravels and year class recruitment. Provide periodic spring flushing flows of 300 to 400 cfs to clean gravels.	Not significant
	Annual October-November shutdown of Syar Tunnel for 4 weeks every 7 to 10 years could impair brown trout spawning success and lower predicted trout standing crop, but would not affect the long-term trout standing crop.	Not significant	None	Not significant
Upper Spanish Fork River	The baseline trout standing crop of 204 lb would increase to 927 lb (a 354 percent increase over baseline)	Significant	None	Not significant
	Annual October-November shutdown of Syar Tunnel for 4 weeks every 7 to 10 years could impair brown trout spawning success and lower predicted trout standing crop, but would not affect the long-term trout standing crop.	Not significant	None	Significant
Lower Spanish Fork River (Strawberry Diversion Dam to Mill Race Canal)	The baseline trout standing crop of 17 lb would increase to 553 lb (a 3,153 percent increase over baseline)	Significant	None	Significant
Lower Spanish Fork River (Mill Race Diversion to Utah Lake	The increased July and August flows reaching Utah Lake (from 3 and 5 cfs to 16 and 10 cfs) would benefit native fish, but may not create a viable trout fishery because of temperature limitations.	Significant	None	Significant

Table 3.6-10
Summary of Impacts on Aquatic Resources

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Feature	Impact	Significance	Mitigation	Significance After Mitigation
Salt Creek through Nephi	The baseline trout population of 112 lb would be reduced by 7 percent (8 lb of trout annually) as 1,600 feet of irrigation ditch providing 7 percent of the total 2.15 acres of trout habitat would be eliminated.	Significant	None	Significant
West Creek	Increased flow would improve instream habitat.	Not significant	None	Not significant
Upper Currant Creek	Increased flow would improve instream habitat.	Not significant	None	Not significant
Mona Reservoir	Decreased salinity levels would improve aquatic habitat.	Not significant	None	Not significant
	The anticipated 1-foot drop in water elevation from baseline conditions would decrease YOY yellow perch habitat through the summer. This would also cause a greater loss of reservoir YOY to downstream Currant Creek as fish are crowded into the pool by the unscreened outlet structure.	Not significant	No mitigation is required because the reduction in YOY and subsequently adult yellow perch standing crop would be offset by the decreased frequency of the reservoir going dry or being reduced to its dead pool elevation	Not significant
Lower Currant Creek	Year-round flows and reduced salinity would benefit the warmwater aquatic biota by increasing sustainable habitat.	Significant	None	Significant
Beer Creek and Benjamin Slough	Increased flows of 18 percent would improve instream habitat.	Not significant	None	Not significant
MCAPW-DFT Alternative				
Sixth Water Creek, Diamond Fork Creek, lower Spanish Fork River below Mill Race Diversion, and Juab Valley creeks	Same as Proposed Action			
Upper Spanish Fork River	The baseline trout standing crop of 204 lb would increase to 798 lb (a 291 percent increase over baseline)	Significant	None	Significant

Table 3.6-10
Summary of Impacts on Aquatic Resources

Feature	Impact	Significance	Mitigation	Significance After Mitigation
Lower Spanish Fork River (Strawberry Diversion Dam to Mill Race Canal)	The baseline trout standing crop of 17 lb would increase to 638 lb (a 3,653 percent increase over baseline)	Significant	None	Significant
MCAP Alternative				
Upper Sixth Water Creek	Same as Proposed Action			
Lower Sixth Water Creek	The baseline trout standing crop of 691 lb would increase to 1,210 lb (a 75 percent increase over baseline)	Significant	None	Significant
	Potential impacts from low temperatures and annual tunnel shutdown would be the same as Proposed Action	Not significant	None	Significant
	Approximately 0.8 acre of riverine trout habitat lost to inundation by Monks Hollow Reservoir (loss of 58 pounds of trout annually)	Significant	Loss offset by trout increases in Sixth Water and Diamond Fork Creeks	Not significant
Cottonwood Creek and Diamond Fork Creek above Three Forks	A combined 0.4 acre of riverine trout habitat lost to inundation by Monks Hollow Reservoir (loss of 43 pounds of trout annually)	Significant	Loss offset by trout increases in Sixth Water and Diamond Fork Creeks	Not significant
Diamond Fork Creek below Three Forks	Approximately 7.1 acres of riverine trout habitat lost to inundation by Monks Hollow Reservoir (loss of 510 pounds of trout annually)	Significant	Loss offset by trout increases in Sixth Water and Diamond Fork Creeks	Not significant
Diamond Fork Creek below Monks Hollow	Same as Proposed Action, except sedimentation of Diamond Fork Creek spawning gravels would be less likely to occur because Monks Hollow Dam would retain 92 percent of sediment from upstream sources.			
Upper and lower Spanish Fork River, and Juab Valley streams	Same as Proposed Action			

Table 3.6-10
Summary of Impacts on Aquatic Resources

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Feature	Impact	Significance	Mitigation	Significance After Mitigation
MCAPW Alternative				
All stream reaches except upper Spanish Fork River	Same as MCAP Alternative			
Upper Spanish Fork River	The baseline trout standing crop of 204 lb would increase to 798 lb (a 291 percent increase over baseline)	Significant	None	Significant
MCATC Alternative				
All water in the impact area of influence	Same as MCAP Alternative.			
MCAT Alternative				
All stream reaches except upper and lower Spanish Fork River	Same as MCAP Alternative			
Upper and lower Spanish Fork River	Same as MCAPW Alternative			
No Action Alternative				
Upper Sixth Water Creek	Same as Proposed Action.			
Lower Sixth Water Creek	The baseline trout standing crop of 691 lb would increase to 2,150 lb (a 311 percent increase over baseline)	Significant	None	Significant
Diamond Fork Creek above Three Forks	Approximately 1 acre of riverine trout habitat would be lost to inundation by Three Forks Reservoir (a loss of 72 lb of trout annually)	Significant	Loss offset by trout increases in Sixth Water and Diamond Fork Creeks	Not significant
Cottonwood Creek	Approximately 0.1 acre of riverine trout habitat would be lost to inundation by Three Forks Reservoir (a loss of 11 lb of trout annually)	Significant	Loss offset by trout increases in Sixth Water and Diamond Fork Creeks	Not significant
Diamond Fork Creek above Three Forks	Approximately 0.5 acre of riverine habitat would be lost to inundation from Three Forks Dam (a loss of 54 lb of trout annually)	Significant	Loss offset by trout increase in Sixth Water and Diamond Fork Creeks	Not significant

Table 3.6-10
Summary of Impacts on Aquatic Resources
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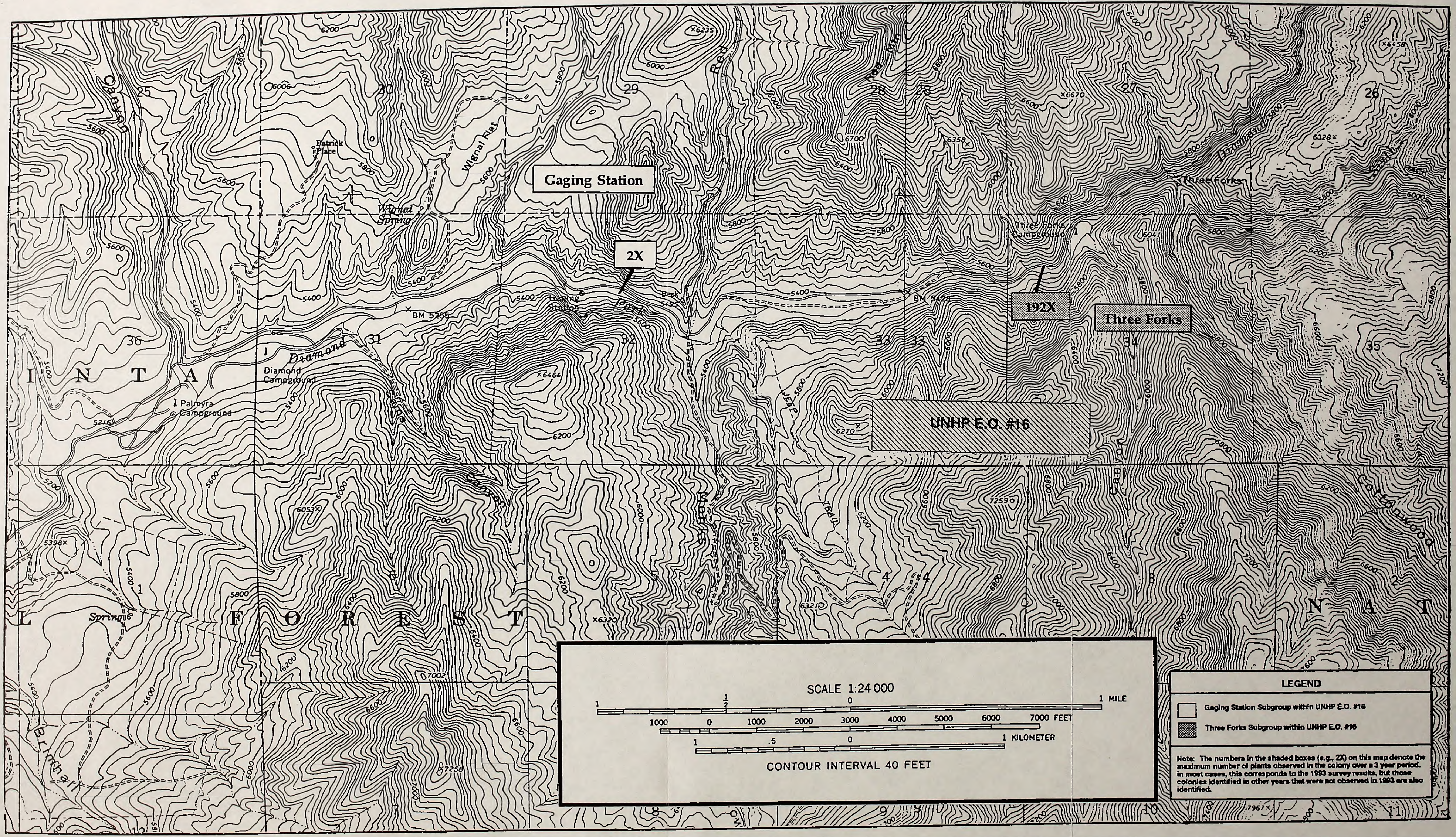
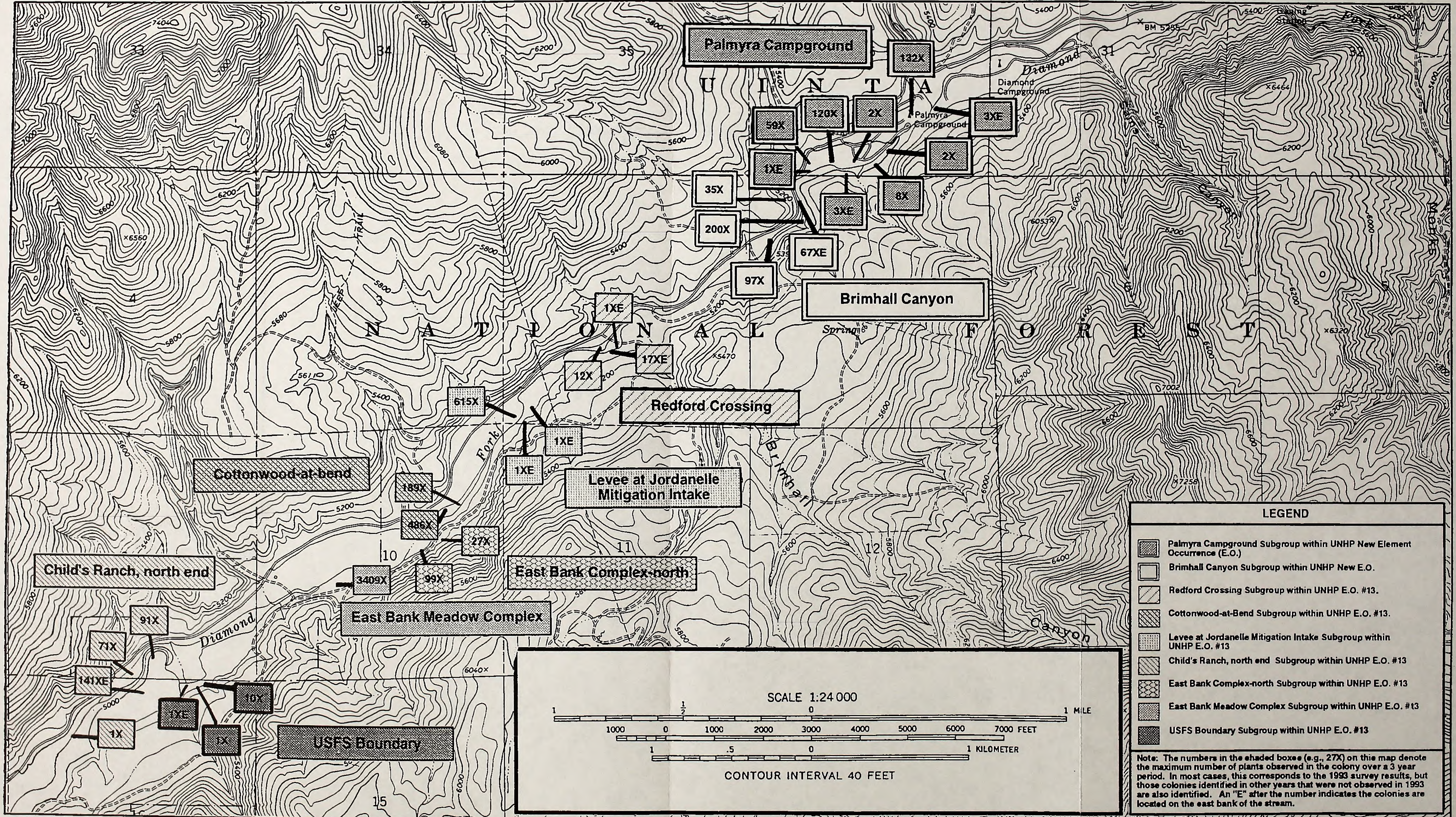
Feature	Impact	Significance	Mitigation	Significance After Mitigation
Diamond Fork Creek below Monks Hollow	Same as Proposed Action			
Upper Spanish Fork River	The baseline trout standing crop would increase from 204 lb to 316 lb (a 55 percent increase).	Not significant	None	Not significant
Beer Creek and Benjamin Slough	Increased flows of approximately 10 percent and approximately 3 percent reduction in salinity would improve instream habitat.	Not significant	None	Not significant
Salt Creek Ditch	Local development would cause a 7 percent decrease in trout standing crop.	Significant	None proposed	Significant

3.6.7 Cumulative Impacts

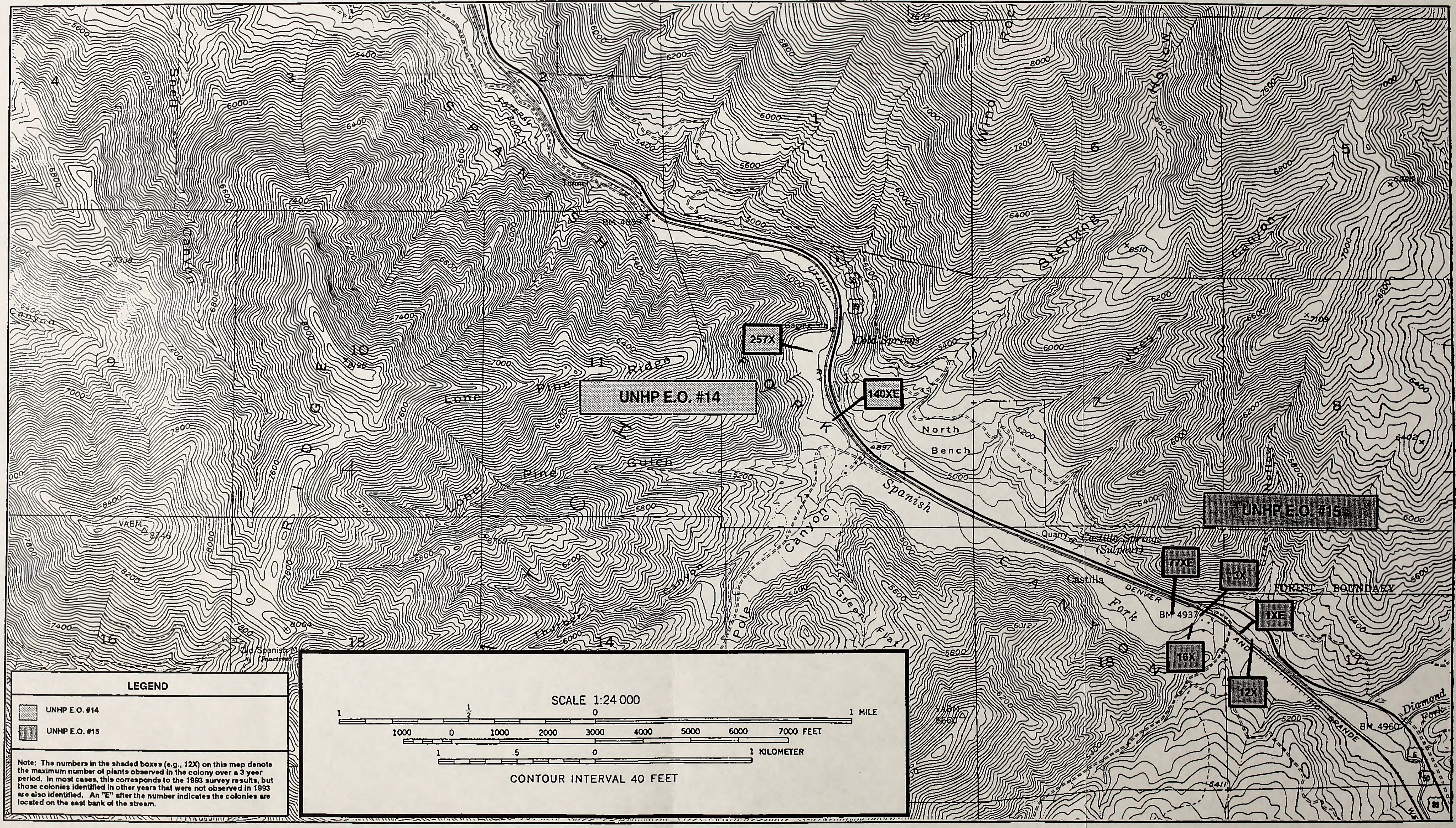
Two projects in the Diamond Fork Creek watershed have been identified that would result in cumulative impacts to aquatic resources. The restoration plans for Sixth Water and Diamond Fork Creeks, in conjunction with the CUPCA-mandated flows of the Proposed Action and its alternatives, would result in a cumulative beneficial impact to the fisheries of these creeks. These same flow enhancements associated with the SFN System would also support the USFS goal of providing for increased fishing demands on the Uinta National Forest (USFS undated).



Map 3.7-1
Location of Ute Ladies'-Tresses Within the Upper Reach of Diamond Fork Creek



Map 3.7-2
Location of Ute Ladies'-Tresses Within the Lower Reach of Diamond Fork Creek



Map 3.7-3
Location of Ute Ladies'-Tresses Within the Spanish Fork Canyon

3.7 Special-Status Species

3.7.1 Introduction

The information and analysis provided in this section was summarized from the *Special-Status Species Technical Report* (CUWCD 1998c) and the *Environmental Contaminants Technical Report* (CUWCD 1997a). This section addresses the impact of the SFN System and related distribution, on-farm, and M&I systems on special-status species, including threatened and endangered plant and animal species and species of special concern present within the SFN System impact area of influence. Also covered are species that have been named as "candidate species" for listing by the federal government (FWS 1992c) and "sensitive" by the State of Utah (Utah Division of Wildlife Resources 1997a).

During the public scoping process for the SFN System, the U.S. Fish and Wildlife Service (FWS) provided input (FWS 1993b; FWS 1995b) on the special-status species that should be addressed when analyzing the potential impacts of the construction and operation of the SFN System. The FWS also identified the species that should be addressed when assessing the effects of the coordinated operation of the SFN and Diamond Fork Systems on Diamond Fork Creek (FWS 1994g). The same species were except that the Diamond Fork list included six additional fish species associated with the Colorado River System. These species were added because of potential impacts caused by historical depletion of water in the Colorado River System resulting from transbasin diversion of water to the Diamond Fork System. The indirect effects of the operation of the SFN System on critical habitat in the Duchesne River for these Colorado River fish species are discussed in Chapter 2, Section 2.3.4.

The list of special-status species provided by the FWS for the SFN System and the Diamond Fork System is shown in Table 3.7-1. The Utah Division of Wildlife Resources list of sensitive species was also reviewed; species from that list are also included in Table 3.7-1.

Five of the species listed in Table 3.7-1 are currently listed as threatened or endangered under the Endangered Species Act (ESA) (FWS 1993b). One species, least chub (*Iotichthys phlegethontis*), is proposed for listing as endangered under the ESA. On July 19, 1995, the FWS modified the definition of candidate species to include only those species for which sufficient information is available to indicate listing (e.g., species previously identified as Category 1 candidates) (FWS 1995c). As a result, species previously identified as Category 2 or Category 3 species are no longer considered candidates for listing under the ESA. These species are addressed in this DEIS as "species of special concern."

3.7.2 Issues Eliminated from Further Analysis

No issues were eliminated from further analysis.

3.7.3 Issues Addressed in the Impact Analysis

Potential impacts on threatened, endangered, and other species of special concern from construction, operation, and maintenance of the Proposed Action and alternatives are addressed in this impact analysis.

Table 3.7-1
List of Special-Status Species for the SFN System **Page 1 of 4**

Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Plant Species			
Ute ladies'-tresses *Spiranthes diluvialis*	T	Riparian edges, gravel bars, old oxbows, and moist to wet meadows along springs and streams.	Species present within the impact area of influence along Diamond Fork Creek and the Spanish Fork River.
Deseret milkvetch *Astragalus desereticus*	C	Mixed sagebrush, mountain brush, juniper communities.	Only known population is within the Spanish Fork River drainage near the town of Birdseye. Species not likely present within the impact area of influence.
Garrett bladderpod *Lesquerella garrettii*	SC	Alpine tundras and subalpine communities on limestone parent material.	Populations have been identified in Utah and Wasatch Counties. Suitable habitat not present within the impact area of influence.
Tidestrom's beardtongue *Penstemon tidestromii*	SC	Desert shrub, sagebrush, and pinyon juniper.	Most populations occur south of Nephi in Juab County. One population is located east of Nephi adjacent to the impact area of influence.
Fish Species			
Leatherside chub *Gila copei*	SC	Variety of habitats including a range of substrate types, flows, cover types, and instream microhabitats.	Found in Diamond Fork Creek, the Spanish Fork River, and Spring Creek.
Least chub *Iotichthys phlegethontis*	PE	Lowland springs and streams that provide cover.	In November 1995, the Utah Division of Wildlife Resources discovered least chub occurring in Juab County in a wetlands complex near Burraston Ponds.
June sucker *Chasmistes liorus*	E	Utah Lake and the lower Provo River.	Status, distribution, life history requirements, and potential impacts to the June sucker as a result of the operation of the Bonneville Unit are discussed in Chapter 2.
Bonneville cutthroat trout *Oncorhynchus clarki utah*	SC	High elevation streams with uniferous and deciduous riparian trees to low elevation streams in sage, steppe, and grassland containing herbaceous riparian zones. It also does well in lake habitats.	No pure strains have been found within the SFN System impact area of influence.
Invertebrate Species			
Utah hydroporus diving beetle *Hydroporus utahensis*	SC	Weedy shallows of lakes, ponds, and streams.	Suitable habitat exists around Utah Lake, but the species may be extinct.
Utah valvata snail *Valvata utahensis*	E	Free-flowing, clear, cool water associated with large spring complexes.	Believed to be extirpated in Utah.
Utah physa (=Utah bubble snail) *Physella utahensis (=Physa u.)*	SC	Well-vegetated, spring-fed pools, with substrate of mud, sand, gravel, or rocks.	Species could be present at Holladay Springs and/or private lands.
Thickshell pondsnail (=Utah bandsnail) *Stagnicola utahensis (=Lymnaea kingii)*	SC	Large bodies of water although some found in spring-fed ponds.	May exist in isolated habitats around Utah Lake.
California floater (mussel) *Anodonta californiensis*	SC	Spring-fed, open water/aquatic bed.	Habitat in impact area of influence is limited to emergent marsh at western edge of cold springs.

Table 3.7-1
List of Special-Status Species for the SFN System

Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Eureka mountainsnail *Oreohelix eurekensis eurekensis*	SC	Northern portion of Tintic Mountains near Eureka, Utah	Species is not found within or near the impact area of influence.
Amphibians			
Spotted frog *Rana pretiosa**	C	Cool, clear spring-fed water with an organic substrate.	Suitable habitat exists within the impact area of influence in both Utah and Juab Counties. Known populations occur in Utah Lake and Spanish Fork River.
Western boreal toad *Bufo boreas boreas*	SC[1]	Small, permanent, high-elevation ponds, high grass, and naturally occurring hibernacula with moving subwaters.	May exist in the Goshen Bay area.
Pacific chorus frog *Pseudacris regilla*	SC[4]	Low plant growth near water in a variety of habitats.	Species is not likely to occur within the impact area of influence.
Birds			
Bald eagle *Haliaeetus leucocephalus*	T	Frequent estuaries, large lakes, reservoirs, major rivers, and some sea coasts. Habitat also must include perching and nesting areas.	Commonly observed from October through March around Utah Lake, Mona Reservoir, lower Diamond Fork Creek, and scattered wetlands.
Peregrine falcon *Falco peregrinus*	E	Cliffs or man-made surrogates such as buildings and bridges near water.	Spring and fall residents in the impact area of influence by Mona Reservoir and Utah Lake.
Yellow-billed cuckoo *Coccyzus americanus occidentalis*	T[1]	Woodlands along streams in lower valleys.	Uncommon summer resident in favored habitats. Last recorded sighting in Santaquin in 1973.
Golden eagle *Aquila chrysaetos*	SC[2]	Nests in cliffs and occasionally in large trees. Cliffs in the impact area of influence have sagebrush and pinyon-juniper areas.	Common throughout Utah and Juab Counties. Active nesting sites include Diamond Fork Canyon, Red Hollow, Goshen Canyon, and West Mountain.
Northern goshawk *Accipiter gentilis*	SC	General forest habitat.	No suitable nesting sites within the impact area of influence, but individuals have been observed at Mona Reservoir.
Ferruginous hawk *Buteo regalis*	SC	Arid, semi-arid, and grassland regions, as well as sagebrush and pinyon-juniper habitats.	No nesting occurs within the impact area of influence, but foraging occurs within grasslands and agricultural areas.
Western burrowing owl *Athene cunicularia hypugea*	SC	Open, dry grasslands, desert habitats, and grass and open shrub stages of pinyon-juniper and ponderosa pine habitats.	No known nesting sites occur within the impact area of influence, but two adults have been observed near Burraston Ponds during the last few years.
Short-eared owl *Aslo flammeus*	SC[4]	Central and northern Utah wetlands and deserts.	Potential suitable habitat exists within the impact area of influence.
Western least bittern *Ixobrychus exilis hesperis*	SC	Freshwater marshes.	No known occurrences within the impact area of influence.
White-faced ibis *Plegadis chihi*	SC	Wetland areas adjacent to agricultural fields.	Numerous flocks have been recorded in Provo Bay and Goshen Bay.

Table 3.7-1
List of Special-Status Species for the SFN System
Page 3 of 4

Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Western snowy plover *Charadrius alexandrinus nivosus*	SC	Flat, open areas with sandy or saline substrates adjacent to seasonal or permanent bodies of water.	Suitable habitat may occur at Goshen Bay and Benjamin Slough.
Black tern *Chlidonias niger*	SC	Freshwater marshes and adjacent fields and grasslands.	Uncommon in Utah; none have been located within the impact area of influence.
Loggerhead shrike *Lanius ludovicianus*	SC[3]	Sagebrush and pinyon-juniper, open habitat.	Occur in suitable habitat throughout the impact area of influence.
Swainson's hawk *Buteo swainsoni*	SC[4]	Trees near open desert grasslands, shrub-steppes, and agricultural fields.	Suitable habitat occurs within the impact area of influence.
Caspian tern *Sterna caspia*	SC[4]	Great Salt Lake wetlands, islands, dikes, and occasionally similar habitats in Utah Lake.	Suitable habitat occurs within the impact area of influence.
Common yellowthroat *Geothlypis trichas*	SC[4]	Riparian and wetland habitats statewide.	Suitable habitat occurs within the Diamond Fork drainage.
Yellow-breasted chat *Icteria virens*	SC[4]	Dense riparian thickets of lower valleys and canyons statewide.	Suitable habitat occurs within the impact area of influence.
American white pelican *Pelecanus erythrorhynchos*	SC[4]	Nests in a large colony in the Great Salt Lake (and formerly on Utah Lake), but forages in freshwater wetlands and lakes.	Suitable habitat occurs within the impact area of influence.
Sage grouse *Centrocerus urophasianus*	SC[4]	Large expanses of sagebrush.	Area surrounding lower Currant Creek downstream on Mona Reservoir.
Long-billed curlew *Numenius americanus*	SC[4]	Upland meadows and rangelands of northern and central Utah valleys. Forages in moist meadow wetlands and upland habitats.	Potential suitable habitat exists along lower Spanish Fork River near Utah Lake, in the springs around Burraston Ponds, and in the meadows near Mona Reservoir.
Grasshopper sparrow *Ammodramus savannarum*	SC[4]	Dry grasslands characterized by short to mid-height clumps of grass with few to no shrubs.	Potential habitat may exist within the impact area of influence, but no known populations exist.
Mammals			
Pygmy rabbit *Brachylagus idahoensis*	SC	Dense stands of sagebrush and rabbitbrush with friable soils.	The impact area of influence is within the range of the pygmy rabbit, but contains very little suitable habitat.
Spotted bat *Euderma maculatum*	SC	Arid desert-shrubs and grassland through mixed conifer and ponderosa pine, and subalpine forests with the presence of cracks and crevices in limestone.	Loafer Mountain provides suitable roosting habitat, but no sightings or collections have been documented.
Fringed myotis bat *Myotis thysanodes*	SC	Range from desert scrub communities to fir tree stands in mountains.	No recorded nesting or roosting has been reported in the impact area of influence.
Long-eared myotis bat *Myotis evotis*	SC	Conifer, pinyon-juniper communities in the mountains. Roosts in caves, mines, and tunnels.	No recorded nesting or roosting has been reported in the impact area of influence.

Table 3.7-1
List of Special-Status Species for the SFN System
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Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Long-legged myotis bat *Myotis volans*	SC	Mainly conifer forests, but also along water courses in deserts.	No recorded nesting or roosting has been reported in the impact area of influence.
Small-footed myotis bat *Myotis ciliolabrum*	SC	Rocky canyon habitats in desert and semi-desert regions.	Occurs throughout the Intermountain West.
Pale Townsend's (=western) big-eared bat *Plecotus townsendii pallescens*	SC	Scrub plant communities, pine, pinyon-juniper,and deciduous forests. Can also be found in deserts.	No recorded nesting or roosting has been reported in the impact area of influence.
Allen's big-eared bat *Idionycteris phyllotis*	SC[4]	Widely distributed throughout lower two-thirds of Utah.	No recorded nesting or roosting has been reported in the impact area of influence.
North American wolverine *Gulo luscus*	SC	High mountains and arctic tundra regions.	No sightings have been reported in the impact area of influence.
North American lynx *Felis lynx canadensis*	SC	Forested areas	No sightings have been reported in the impact area of influence.
Reptiles			
Utah mountain king snake *Lampropeltis pyromelana infralabialis*	SC[4]	Chaparral woodland and pine forests in mountainous regions and bushy, rocky canyons, talus slopes, and near streams and springs above 2,800 feet.	Suitable habitat does not exist within the impact area of influence.
Utah milk snake *Lampropeltis triangulum taylori*	SC[4]	Semi-arid regions, pine forests, deciduous woodlands, and suburban areas.	Potential suitable habitat occurs within the impact area of influence.

*The scientific name of the spotted frog was recently changed from *Rana pretiosa* to *Rana lutreventris*.

T = Listed as threatened under the ESA of 1973, as amended.
T[1] = Listed as threatened by the State of Utah.
E = Listed as endangered under the ESA.
PE = Proposed for listing as endangered under the ESA.
C = A candidate for listing under the ESA.
SC = Species of special concern.
SC[1] = The FWS has reviewed a petition to list the Southern Rocky Mountain population of the western boreal toad as endangered and concluded that listing is warranted but precluded at this time. However, the Utah population was not included in the listing.
SC[2] = Golden eagle is protected under the Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 701-718h).
SC[3] = Utah population of loggerhead shrike is no longer included on candidate species list.
SC[4] = State of Utah species of special concern.

3.7.4 Description of Impact Area of Influence

The impact area of influence for special-status species includes both terrestrial and aquatic habitats in southern Utah and eastern Juab Counties that could be directly or indirectly affected by the construction, operation, and maintenance of the SFN System and related actions (local development). This impact area of influence includes the Diamond Fork drainage area (i.e., Diamond Fork Canyon and its various tributary canyons, including Sixth Water and Red Hollow) and the Spanish Fork River to the northeast; Hobble Creek and Utah Lake to the north; Currant Creek and West Creek to the west; the Wasatch Mountains to the east; and the San Pitch Mountains to the south.

The specific impact area of influence examined varies for each of the three main species groups (i.e., plants, fish, and wildlife) depending upon distribution and habitat requirements. For example, the area examined for fish species was restricted to perennial streams and water bodies, whereas the impact area of influence for plant species included riparian and wetland habitats.

3.7.5 Affected Environment

3.7.5.1 Proposed Action and All Action Alternatives

The affected environment for the Proposed Action includes the Diamond Fork drainage area where the various features of the Diamond Fork System (i.e., the "Diamond Fork Tunnel Alternative," Monks Hollow Dam and Reservoir, or Three Forks Dam and Reservoir, depending on the alternative) would be constructed. It also extends from the confluence of the Spanish Fork River and Diamond Fork Creek down to Nephi, encompassing the area where the Main Conveyance Aqueduct and associated facilities would be built. The following subsections describe the affected environment for each of the special-status species located within the impact area of influence and listed in Table 3.7-1.

3.7.5.1.1 Threatened and Endangered Species

3.7.5.1.1.1 Plants

Ute Ladies'-Tresses. Listed in 1992, the Ute ladies'-tresses is the only threatened plant species found in the impact area of influence. The species is a perennial orchid that occurs along riparian edges, gravel bars, old oxbows, and moist to wet meadows along perennial freshwater streams and springs at elevations ranging from approximately 4,300 to 7,000 feet (FWS 1992b; Stone 1993). It is an early successional species that is well-adapted to colonizing banks and low floodplains along alluvial streams where scouring and sediment deposition are natural processes. It has also been found in irrigated and sub-irrigated pastures that are mowed or moderately grazed. In general, the orchid occurs in relatively open grass and forb-dominated habitats, seeming intolerant of dense shade. The plants bloom from late July through August or sometimes September, setting seed in the early fall (FWS 1992b).

The currently identified distribution of the Ute ladies'-tresses includes three general areas: 1) riparian areas along the eastern front of the Rocky Mountains in north-central and central Colorado and southeastern Wyoming; 2) low elevation riparian areas in the Colorado River drainage in Garfield, Duchesne, Uintah, Wayne, and Daggett Counties in eastern Utah; and 3) the Bonneville Basin along the Wasatch Front in western Utah and the eastern Great Basin of Utah (historically in Nevada). Along the Wasatch Front, populations have been identified in the wetlands near Utah Lake and along the Provo River, Diamond Fork Creek, and the Spanish Fork River.

Field surveys were conducted for the Ute ladies'-tresses in the Diamond Fork drainage area, along the riparian wetlands and floodplains of the Spanish Fork River, and in areas in eastern Juab County potentially receiving return flows from the SFN System (e.g., the wet meadows around the perimeter of Burraston Ponds, scattered locations along West Creek, and the spring-fed headwaters of upper Currant Creek). No individuals were located in the eastern Juab County survey areas (Stone 1993). As discussed in more detail below, a total of 45 colonies were identified along the Spanish Fork River and Diamond Fork Creek during surveys conducted between 1992 and 1994. It is believed that these colonies represent a single large population, consisting of more than 95 percent of all the individuals counted within the last 5 years along the Wasatch Front (FWS 1992b).

Diamond Fork Drainage. During the winter of 1996-97, a field survey was conducted to determine whether suitable habitat for Ute ladies'-tresses exists along Diamond Fork and Sixth Water Creeks upstream of Three Forks (Woodward-Clyde 1997). Areas surveyed included Diamond Fork Creek from the proposed Tanner Ridge Tunnel

Table 3.7-3
Number of Flowering Ute Ladies'-Tresses Counted in the Spanish Fork River Survey Area 1992-1994

E.O. No.	Location	Colony	Number of Individuals 1992	1993	1994
14	Just upstream of the Strawberry Diversion Dam (T9S, R3E, Sec. 12, N 1/4 of SW 1/4)	1 North bank[a]	24	140	22
		2 South bank	--	0	27
		3 Meander scar	--	257	25
		E.O. 14 Total	**24**	**397**	**74**
15	Shurtz Canyon vicinity (T9S, R4E, Sec. 17, SW 1/4 of NW 1/4)	1 South bank near Bow Valley Reservoir[b]	3	12	10
		2 South bank near Bow Valley Reservoir	0	0	1
		3 Instream gravel bars	0	3	0
		4 North bank downstream Shurtz Canyon	0	16	0
		5 North bank downstream Colony No. 4	0	77	2
		E.O. 15 Total	**3**	**108**	**13**
Spanish Fork River Total			**27**	**505[c]**	**87**

[a]In 1992, two small colonies on the north bank and one on the south bank were identified with the actual number of individuals in each unknown.
[b]Identified as two separate colonies in original survey but coalesced to form a single colony in subsequent surveys.
[c]The maximum number of individuals observed in a single year does not equal the sum of the maximum number of individuals observed in a colony within all 3 years of surveys. To calculate the maximum total, the maximum number of individuals observed within a colony was identified (i.e., 140 for E.O. 14, Colony 1; 27 for E.O. 14 Colony 2; and 257 for E.O. 14 Colony 3). The individual colony maximum numbers were then combined to obtain a maximum total for the entire population (e.g., the maximum total for E.O. 14, Colony 1, is 140+27+257, or 424). The maximum total observed over the 3-year period is 533 individuals.

Least Chub. The least chub is one of North America's smallest minnows, seldom measuring more than 2.5 inches. It is endemic to the Bonneville Basin of Utah. As recently as the 1950s, it was relatively common in streams and springs along the Wasatch Front, but today it is known to exist in a few springs in Snake Valley near the Nevada border (Sigler and Miller 1963; Holden et al. 1974). Within the impact area of influence, it was common in many lowland springs and streams in the late 1800s (Jordan 1891) and was collected in the Provo River (Sigler and Miller 1963). Therefore, it likely was distributed throughout the impact area of influence at one time.

The FWS has conducted three status reviews for least chub and has prepared two status reports. In 1980, the FWS reviewed existing information on least chub and determined that there was insufficient data to warrant its listing as endangered or threatened. On December 30, 1982, the FWS classified this species as a Category 2 candidate species (47 FR 58454). After preparation of a 1989 status report, the FWS reclassified least chub as a Category 1 candidate species (54 FR 554). In 1995, the FWS determined that listing least chub as an endangered species was warranted and on September 29, 1995, proposed to list the species as endangered with critical habitat, pursuant to the ESA (60 FR 50520).

Table 3.7-2
Comparison of the Location and Abundance of Ute Ladies'-Tresses in the Diamond Fork Creek Survey Area 1992-1994

Page 2 of 2

E.O.	Location	Colony ID	Number of Individuals		
			1992	1993	1994
13	East Bank Complex - North	23	0	27	GI*
		24	1	99	GI*
	East Bank Meadow Complex	25	8	662	GI*
		26	203	2,214	GI*
		27	0	426	GI*
		28	19	97	GI*
		29	0	2	GI*
		30	0	8	GI*
	USFS Boundary	31	10	0	0
		32	1	0	0
	Child's Ranch, North End	33	0	1	0
		34	0	91	177
		35	0	71	10
		36	0	141	138
	E.O. 13 Subtotal		**279**	**5,161**	**416**
Diamond Fork Creek Total			**302**	**6,049**	**804**

*GI = Grazing heavily impacted this area. Although there were flowering individuals at the time of this survey, most were trampled or otherwise disturbed; therefore none were recorded.
Note: The maximum number of individuals observed in a single year does not equal the sum of the maximum number of individuals observed in a colony within all 3 years of surveys. To calculate the maximum total, the maximum number of individuals observed within a colony was identified. The individual colony maximum numbers were then combined to obtain a maximum total for the entire population (e.g., the maximum total for Brimhall Canyon is 200+35+67+200, or 502). The maximum total observed over the 3-year period is 6,286 individuals.

Table 3.7-2
Comparison of the Location and Abundance of Ute Ladies'-Tresses in the Diamond Fork Creek Survey Area 1992-1994

Page 1 of 2

E.O.	Location	Colony ID	Number of Individuals 1992	1993	1994
16	Three Forks	1	23	192	23
	Gaging Station	2	0	2	1
	E.O. 16 Subtotal		**23**	**194**	**24**
New	Palmyra Campground	3	0	3	5
		4	0	132	40
		5	0	2	0
		6	0	8	8
		7	0	2	0
		8	0	3	1
		9	0	120	75
		10	0	59	0
		11	0	1	0
	Brimhall Canyon	12	0	200	0
		12A	0	0	35
		13	0	67	0
		14	0	97	200
	E.O. (New) Subtotal		**0**	**694**	**364**
13	Redford Crossing	15	0	1	0
		16	0	17	0
		17	4	12	0
	Levee at Jordanelle Wetland Mitigation Intake	18	0	1	0
		19	0	1	0
		20	27	615	91
	Cottonwood-at-Bend	21	5	486	GI*
		22	1	189	GI*

outlet to Three Forks; Sixth Water Creek from Three Forks upstream 2.5 miles; and Fifth Water Creek from its confluence with Sixth Water Creek to 2.75 miles upstream.

The section of Diamond Fork Creek above Three Forks has few low terraces, and most of the terraces are higher than 18 inches above the mean August water surface elevation. It was concluded that the potential for Ute ladies'-tresses habitat along Diamond Fork Creek upstream of Three Forks is very low. Along Sixth Water Creek, high flows during the irrigation season have incised the creek channel below the apparent historic canyon bottom to the extent that suitable habitat for Ute ladies'-tresses was not found. It was concluded that the potential for Ute ladies'-tresses habitat along Sixth Water Creek is insignificant. Along Fifth Water Creek, the high gradient, mature overstory, incised channel, and vast pool-riffle complexes supported a similar conclusion.

Along Diamond Fork Creek from the Spanish Fork River to Three Forks, three element occurrences (E.O.) (the formal name used by the Utah National Heritage Program [UNHP] to specify species locations) of Ute ladies'-tresses were identified during the 1992 and 1993 surveys (see Maps 3.7-1 and 3.7-2). E.O. 13 corresponds to the lower braided reach from the confluence with the Spanish Fork River to Brimhall Canyon, and E.O. 16 occurs within the confined upstream reach from Diamond Campground to Three Forks. The third E.O. (for which a number has not yet been assigned) encompasses the meandering reach between Brimhall Canyon and Diamond Campground. The largest concentration of Ute ladies'-tresses colonies occurs in the extensively meandering and braided lower reach from Brimhall Canyon to the Spanish Fork River. Individuals are scattered throughout this section, with large groups occurring within those gravel bar wetlands exhibiting the greatest extent of geomorphic complexity. Other areas with high concentrations of Ute ladies'-tresses include the point bars downstream of Palmyra Campground and the large meadow complex adjacent to the levee at the Jordanelle wetland mitigation intake. No individuals were located along single-channel stream sections with poorly developed floodplains.

The numbers of flowering individuals observed during each of the 3 years of census varied greatly. A low of 302 individuals was observed in 1992 and a high of 6,049 was observed in 1993 as shown in Table 3.7-2. A maximum total of 6,286 individuals was identified during the 3-year survey period.

Spanish Fork River. Along the Spanish Fork River, two element occurrences (E.O.) were located in 1992 by UNHP botanists in Spanish Fork River riparian wetlands. Map 3.7-3 shows the location of E.O. 14 just upstream of the Strawberry Diversion Dam (opposite the Cold Springs wetland) and E.O. 15, which is within the vicinity of Shurtz Canyon. Both E.O.'s were located again in 1993 and 1994, but a yearly variation in the number of individuals was observed, as shown in Table 3.7-3. Because individuals were not observed in all of the colonies each year, including 1993 when most of the plants were identified, the sum of the maximum total number of individuals observed in a colony (i.e., 533) exceeds the total census for any given year. This high degree of fluctuation in population numbers is not unusual for Ute ladies'-tresses or other members of the *Spiranthes* genus (Riedel 1992). This phenomenon appears to occur because the plants do not bloom every year and are difficult to locate when not in bloom. Thus, fluctuations in numbers of observed flowering individuals do not necessarily correspond to population fluctuations or indicate habitat alterations. No individuals were located in the large, heavily overgrazed wetland at the confluence of the Spanish Fork River and Diamond Fork Creek. Channelization and summer diversions also limit the riparian habitat below the Strawberry Diversion Dam (Stone 1993).

*3.7.5.1.1.2 **Fish.*** No threatened or endangered fish species are present within the impact area of influence. (Information on the June sucker (*Chasmistes liorus*) and the Colorado River fish is provided in Chapter 2, Section 2.3). The least chub (*Iotichthys phlegethontis*), proposed for listing as endangered, occurs within the impact area of influence as discussed below.

In November 1995, the Utah Division of Wildlife Resources discovered least chub occurring in Juab County (Lentsch 1995). Approximately 200 least chub were sampled in a wetlands complex near Burraston Ponds southwest of Mona. This new discovery indicates the species' distribution is more extensive than previously thought, and the Utah Division of Wildlife Resources has recommended that the least chub not be listed. In lieu of listing, the Utah Division of Wildlife Resources has prepared a draft Conservation Agreement and Strategy for the least chub (Utah Division of Wildlife Resources 1997b). One of the priority actions in the agreement is to expand least chub populations within historic habitat. The Utah Division of Wildlife, together with the FWS, continues to monitor the Wasatch Front population noted above and it is anticipated that a permanent long-term monitoring plan will be completed prior to the 1998 monitoring field season (Utah Division of Wildlife Resources 1997b).

3.7.5.1.1.3 Invertebrates

Utah Valvata Snail. The Utah valvata snail (*Valvata utahensis*) was listed as endangered in 1992 (FWS 1992a). The species is now restricted to a few isolated free-flowing reaches or spring alcove habitats in the Snake River system in Idaho (Clarke 1991; FWS 1992a). In spite of extensive surveys throughout Utah, no living specimens have been recorded in Utah since collection of the type specimen in 1884 from Utah Lake near Lehi (Clarke 1991). Thus, the species is believed extirpated. The species may, however, still be present in freshwater springs within the impact area of influence near the margin of Utah Lake (Stone 1994).

3.7.5.1.1.4 Amphibians. No listed threatened or endangered amphibian species have been identified within the impact area of influence.

3.7.5.1.1.5 Birds

Bald Eagle. The FWS recently reclassified the bald eagle as threatened throughout most of the United States, including Utah (FWS 1994b). Breeding habitat in Utah is limited, and nesting by bald eagles was not documented until 1984, when one pair was discovered in southeastern Utah (Henny and Anthony 1987). Currently, three known nesting territories have been located in southeastern Utah. Two of these territories were active in 1994 (Bunnell 1994). There are no nesting pairs in the impact area of influence.

Wintering eagle populations in Utah are substantial, with 1,263 recorded in 1985 at scattered locations during the National Wildlife Federation's midwinter survey (Henny and Anthony 1987). Counts conducted by the Utah Division of Wildlife Resources also indicate a general increase in wintering eagles (Bunnell 1994). Individuals are seen commonly in small numbers within the impact area of influence from October through March (Smith and Murphy 1973; USBR 1988c). During this period, eagles are frequently observed around Utah Lake, Mona Reservoir, lower Diamond Fork Creek, Piute Reservoir, and Sevier Bridge Reservoir, as well as in scattered wetlands throughout central Utah (USBR 1988c). Known roosting sites are located at Utah Lake and Mona Reservoir and within cottonwood stands along lower Diamond Fork Creek near Palmyra Campground. Bald eagles frequently use trees around Utah Lake as daytime perches. The primary food sources for this species are fish, rabbits, waterfowl, and carrion (Smith and Greenwood 1983b).

Peregrine Falcon. Three subspecies of peregrine falcon (*Falco peregrinus*) occur in North America: Arctic peregrine falcon (*Falco peregrinus tundrius*), American peregrine falcon (*F. p. anatum*), and Peale's peregrine falcon (*F. p. pealei*). Currently, all peregrines nesting in the lower 48 states are listed as endangered under ESA (FWS 1994e). In 1994, about 200 active nesting territories were recorded in Utah, primarily in the southern part of the state (Bunnell 1994). In addition, peregrines have been re-introduced to northern Utah by the Utah Division of Wildlife Resources using hack towers around Great Salt Lake (Paton 1994). Peregrine falcons are currently considered to be spring through fall residents in the impact area of influence and are seen occasionally during migration near various wetlands such as Mona Reservoir, Utah Lake, and Burraston Ponds (Smith and Greenwood 1983b; USBR 1988c); however, there have been no known active nesting sites in the vicinity of the project since

1968 (Shields and Moretti 1982; Bunnell 1994). Nevertheless, the high cliffs of the Wasatch Front and the proximity of excellent foraging areas around Utah Lake provide conditions suitable for re-establishment of the species in this area (Shields and Moretti 1982).

Yellow-Billed Cuckoo. The State of Utah has listed the yellow-billed cuckoo (*Coccyzus americanus occidentalis*) as a threatened species (Utah Division of Wildlife Resources 1997a). This neotropical migrant species nests in woodlands along streams in lower valleys statewide. The species has declined significantly across its range. It is considered an uncommon summer resident in favored habitats throughout Utah from May to September. The species has been recorded at various locations in Utah County, the most recent being in Santaquin in 1973. A neotropical breeding bird survey conducted in 1996 in the lower Diamond Fork Creek did not report locating the species (Uinta National Forest 1996).

*3.7.5.1.1.6 **Mammals.*** No listed threatened or endangered mammal species have been identified within the impact area of influence.

*3.7.5.1.1.7 **Reptiles.*** No listed threatened or endangered reptile species have been identified within the impact area of influence.

3.7.5.1.2 Species of Special Concern

*3.7.5.1.2.1 **Plants***

Deseret Milkvetch. The Deseret milkvetch (*Astragalus desereticus*) is a candidate species. A listing package for the species has been prepared and is currently under internal FWS review to determine if it should be proposed for listing as threatened or endangered (England 1995). The distribution of the Deseret milkvetch is extremely limited, with only one known population. This population is located outside the impact area of influence near the town of Birdseye. It was rediscovered in 1981, after a period of almost 60 years during which the species had not been seen (Welsh et al. 1993). Recent surveys (i.e., since 1990) of the Spanish Fork River Canyon below Thistle and bordering National Forest lands (Uinta National Forest and Manti-La Sal National Forest) have not identified any additional populations (England 1995).

Garrett Bladderpod. The Garrett bladderpod (*Lesquerella garrettii*) is endemic to north-central Utah (Atwood et al. 1991). According to the literature review and survey report by the UNHP (Tuhy 1991), the Garrett bladderpod occurs in scattered locations in the central Wasatch Mountains from Big Cottonwood Canyon on the north to Provo Peak on the south (including portions of Salt Lake, Utah, and Wasatch Counties). The results of recent surveys regarding the distribution of the species indicate that the species is not located within the impact area of influence (Nelson 1996).

Tidestrom's Beardtongue. The center of the Tidestrom's beardtongue (*Penstemon tidestromii*) distribution is in the San Pitch Mountains, with most occurrences of the species located south of Nephi in Juab and Sanpete Counties (Peterson 1993). Recent surveys by the UNHP found the species to be more abundant than previously thought, especially in the San Pitch Mountains. The northernmost occurrence is located approximately 1.5 miles east of Nephi at an elevation of 6,600 feet. Surveys within the vicinity have not recorded occurrences of Tidestrom's beardtongue north of Salt Creek Canyon (Stone 1995).

*3.7.5.1.2.2 **Fish***

Leatherside Chub. Leatherside chub were found historically in the streams and rivers of the eastern Bonneville Basin of Utah, the Sevier River system, and a few streams in Idaho and Wyoming (Sigler and Miller 1963). Available references indicate that the leatherside chub is a generalist occupying a wide variety of habitats, including a range of substrate types, flows, cover types, and instream microhabitats (Sigler and Sigler 1987;

Keleher 1994; Wilson and Belk 1996). A recent investigation of leatherside chub habitat preferences in the Sevier River found this species at depths of 2.4 inches to 38 inches, at current velocities of 0.2 to 2.5 feet per second, and in temperatures of 34°F to 78°F (Wilson and Belk 1996).

Within the Diamond Fork Creek/Spanish Fork River watershed, populations of leatherside chub exist in Thistle Creek, Soldier Creek, Diamond Fork Creek, and the Spanish Fork River (Shirley 1989 and 1993). Another population of leatherside chub in the SFN System impact area of influence occurs in Spring Creek, a tributary to Benjamin Slough.

The leatherside chub populations in Sixth Water and Diamond Fork Creeks were destroyed in 1990 by an accidental release of rotenone from Strawberry Reservoir (Shirley 1991). In 1991, the Division of Wildlife Resources collected 2,000 leatherside chub from Thistle Creek and stocked these fish at eight locations in the Diamond Fork Creek drainage, including Sixth Water Creek just above Three Forks (Shirley 1991). In November 1993, leatherside chub were reported as being abundant (162 leatherside chub were observed) at the station in Diamond Fork Creek just below Brimhall Canyon (Shirley 1993). The Utah Division of Wildlife Resources sampled Sixth Water Creek 0.1 mile above Three Forks in 1994 but found no leatherside chub (Utah Division of Wildlife Resources 1994c). Sampling by the Utah Division of Wildlife Resources in 1996 and 1997 in Sixth Water Creek at Rays Valley Bridge and near Dip Vat Creek also failed to find leatherside chub (Utah Division of Wildlife Resources 1996 and 1997f).

The most extensive survey of the leatherside chub population in Diamond Fork Creek was conducted during October and November 1996. Sampling between Highway 6 and Monks Hollow found leatherside chub to be common and the most abundant minnow in the stream (Walser et al. 1997). However, leatherside chub were found predominantly in the lower river below Brimhall Canyon where braided channels and backwaters are abundant. Within the lower river, most of the leatherside chub occupied the backwaters and cutoff pool habitats with water depths of less than 12 inches and abundant vegetative cover. The leatherside chub's lack of use of available main channel habitat could be due to the presence of abundant brown trout or it could be a reflection of a previously unknown autumn habitat shift (Walser et al. 1997).

The upper Spanish Fork River fisheries between Diamond Fork Creek and the Strawberry Diversion Dam were surveyed in April and October 1994 and found 4 to 35 leatherside chub at each of four stations. Captured leatherside chub in the Spanish Fork River were occupying sheltered habitat with low to moderate current velocities, typically consisting of undercut banks with tree roots, backwaters, small eddies along the edges of riprapped banks, and the edges of runs adjacent to stream banks.

The 1994 sampling of Juab Valley streams within the impact area of influence found leatherside chub at six sampling sites in the Spring Creek drainage. Based on the numbers of leatherside chub captured at various locations in Spring Creek, the distribution of this species was estimated to include approximately 3.9 miles of stream from Spring Lake to a large irrigation diversion structure between 9900 South Street and 9600 South Street. The highest densities (2,154 and 5,958 fish per mile) were associated with the habitat characteristics of moderate current velocity and flow, cobble/gravel substrate, good water quality with cool temperatures, and a diversity of habitat. Catch data for leatherside chub in Spring Creek suggests that distribution of this species in Spring Creek is not uniform, but associated with areas of suitable habitat as described above. Other factors, such as land use patterns, abundance of predatory and competitive fish species, and local flow regimes are likely to affect habitat suitability and numbers of leatherside chub in localized areas.

June Sucker. The affected environment for the June sucker includes areas outside the SFN System impact area of influence, but is affected by Bonneville Unit operation and described in Chapter 2 of this DEIS.

Bonneville Cutthroat Trout. The Bonneville cutthroat trout still occurs in relatively isolated habitats throughout its historical range; however, less than 5 percent of its original stream habitat is currently known to be inhabited.

The Bonneville cutthroat trout has also been placed by Region 4 of the USFS on its sensitive species list and is recognized as a "Conservation" species (sufficiently managed under a Conservation Agreement) by the State of Utah (FWS 1996). The abundance and quality of the stream and lake habitat once available to Bonneville cutthroat trout have declined as a result of water diversion and degradation of riparian habitats from grazing, road building, mining, and timber harvest. Perhaps the greatest impact to this species is from the introduction of other salmonids. Rainbow trout have hybridized with cutthroat populations throughout the West, and competition and predation from brook trout and brown trout are suspected to have significantly reduced cutthroat numbers (Kershner 1995). Hybridization with other subspecies of cutthroat trout has also reduced pure strains of Bonneville cutthroat trout.

Bonneville cutthroat trout is likely to have existed historically in the Diamond Fork drainage area. However, Martin et al. (1985 cited by FWS 1996) used electrophoresis techniques on cutthroat trout from Shinglemill, Chase, Fifth Water, Wanrhodes, and Little Diamond Creeks and determined that no pure strains of Bonneville cutthroat trout currently exist in the Diamond Fork drainage. At this time, no pure strains of this subspecies of cutthroat are known to occur within the SFN System impact area of influence.

3.7.5.1.2.3 Invertebrates.

Utah Hydroporus Diving Beetle. Little is known about the life history and habitat requirements of the Utah hydroporus diving beetle *(Hydroporus utahensis)*. Related hydroporus beetles prefer weedy shallows of lakes, ponds, and streams (USBR 1988c). It is known only from the type specimen collected from the east side of Utah Lake in 1941 (Gordon 1981). The species could be extinct, although suitable spring habitat around Utah Lake has not been surveyed intensively, and its status is unknown.

Utah Physa. Little is known about the distribution and abundance of the Utah physa (*Physella utahensis [=Physa u.]*) (CH2M Hill 1993). The species was abundant in Lake Bonneville during the Pleistocene and has survived in a few spring-fed pools north of the Great Salt Lake in Box Elder County and in Colorado (Clarke 1991). The Utah physa survived in Utah Lake until at least 1930 (Clarke 1991). Suitable habitat occurs within the project vicinity such as at Holladay Springs, and the species could be present; however, most suitable habitat is on private land, and few surveys have been conducted (Stone 1994).

Thickshell Pondsnail. There is persuasive evidence that the thickshell pondsnail (*Stagnicola utahensis*) is extinct (FWS 1994d). The species is known from fossil remains around Utah Lake (CH2M Hill 1993). It occurred in Lake Bonneville before the lake disappeared in 15,000 B.C. and persisted in Utah Lake until at least the 1930s. The most recent documentation of the species occurring in the area was provided by Chamberlain (1933) in which he reported the species to be commonly associated with freshwater springs flowing into Utah Lake near Pelican Point. Recent surveys by Clarke (1991) determined that the springs at Pelican Point have been destroyed by development, and the thickshell pondsnail is no longer present. Shells of the species have been found in many areas around the project vicinity including the Spanish Fork River and Holladay Springs, and other springs in the area also provide potential habitat. Some experts feel that the species may survive in isolated habitats around Utah Lake, but it has not been discovered because of a lack of survey effort. There is also some evidence that the thickshell pondsnail and the extant *Stagnicola bonnevillensis* are the same species (Clarke 1991).

California Floater. The California floater (*Anodonta californiensis*) occurs in California, Nevada, Utah, and Arizona. In Utah, populations of this species of freshwater mussel are known to occur in only four widely spaced locations: Big Creek in Rich County, Redden Spring Pond near the Nevada border in Tooele County (Clarke and Hovingh 1994), Otter Creek in the upper Sevier River drainage in Piute County, and Juab County northwest of Burraston Ponds (CUWCD 1994b). There is a possibility that it still occurs in the Raft River in Box Elder County. Until the 1930s, the California floater occurred in Utah Lake and Bear Lake, but this species has since been extirpated from these waters. Degradation of water quality and unstable water elevations resulting from irrigation water diversions and storage are the apparent causes of the decline of this mussel species.

Eureka Mountainsnail. The Eureka mountainsnail (*Oreohelix eurekensis eurekensis*) is one of about 24 species and subspecies of the land snail genus *Oreohelix* that have been reported in Utah, many with narrow ranges and specialized habitat requirements. Its range historically and presently is limited to the northern portion of the East Tintic Mountains in Juab and Utah Counties in the general vicinity of the town of Eureka (Clarke and Hovingh 1994). Comparing his 1992-93 survey results with that of a 1917 survey, Clarke concluded that no general population decline has occurred for this species, but warns that a resumption of mining activities in these mountains could potentially jeopardize it. Fire is also a potential threat to isolated populations. This species of snail does not occur within the SFN System impact area of influence (England 1995; Clarke and Hovingh 1994).

3.7.5.1.2.4 Amphibians

Spotted Frog. The range of the spotted frog (*Rana lutreventris*, formerly *Rana pretiosa)* is continuous from extreme southeastern Alaska south through western Alberta, to the Pacific coast in Washington and Oregon (Stebbins 1985). Pritchett et al. (1981) reported small breeding populations associated with springs near Utah Lake and the Provo River during the early 1980s, but by the latter part of that decade, spotted frog populations along the Wasatch Front were believed to be extinct (Hovingh 1988).

In 1989, the FWS was petitioned to list the spotted frog under the ESA (Federal Register 54 [1989]:42529). The FWS ruled on April 23, 1993, that the listing of spotted frog was warranted as a priority 3, but precluded because of higher priorities (Federal Register 58[87]:27260). The major impetus behind the proposed listing was the reduction in distribution associated with impacts from urban and water developments and the introduction of nonnative species in Utah.

In October 1997, the Utah Division of Wildlife Resources issued a draft Conservation Agreement and Strategy for the spotted frog (Utah Division of Wildlife Resources 1997d), which if implemented, could significantly reduce or eliminate threats that warrant listing the spotted frog as a sensitive species. For the Wasatch Front geographic unit, the objective of the Agreement is to establish a minimum of one population in five of the six geographic subunits (Utah Lake, Spanish Fork, Provo River, Lower Sevier River, Lower Weber River, and San Pitch) within the historic range.

Surveys for the spotted frog were conducted in 1994 within eastern Juab and southern Utah Counties to supplement the data collection performed previously by Ross et al. (1993) and to evaluate the potential impacts of the SFN System on the species. These surveys focused on supplementing the existing database within the project area and were not conducted in some areas where previous surveys had located the species. The results of the surveys for both counties and a comparison of this data to the data from Ross' 1992 surveys are provided in Table 3.7-4. A total of 17 spotted frog egg masses were observed in eastern Juab County at one of seven parcels surveyed. Egg masses were found in the vicinity of Burraston Ponds. No other spotted frogs were located at the other six survey sites, although one individual was observed incidentally during focused surveys for special-status fish. In contrast, Ross et al. (1993) recorded 15 adults at four of the 11 survey sites and 61 egg masses at five of the 11 survey sites during 1992 in Juab and Utah Counties. The site northwest of Burraston Ponds where 17 egg masses were observed in 1994 had only four egg masses in 1992. Such variation in annual productivity is not uncommon in small populations of spotted frogs that are affected greatly by small changes in their environment. For example, Hovingh (1993) observed from zero to 33 egg masses over a 5-year span at a small isolated spring in Tule Valley, Utah.

Table 3.7-4
Results of 1992 and 1994 Spotted Frog Surveys in Eastern Juab and Southern Utah Counties*

General Location	1992 Surveys		1994 Surveys	
	Adults	Egg Masses	Adults	Egg Masses
Juab County	1	13	0	17
Utah County	14	48	0	0

*Because of the sensitive nature of the survey data, survey results are not shown for specific locations.

Western Boreal Toad. The FWS has reviewed a petition to list the southern Rocky Mountain population of the western boreal toad (*Bufo boreas boreas*) as endangered under ESA (FWS 1994d). The FWS issued a finding that listing of the population is warranted, but precluded at this time by other higher priority listing actions (FWS 1995a). If enacted at a later date, the listing action as currently proposed would apply only to populations in New Mexico, Colorado, and Wyoming. Although some experts believe that listing of Utah populations of this subspecies may be warranted, the FWS has decided not to include these populations in the current listing review package (Rose 1994). The decision is based primarily on the apparent geographic isolation of the Utah population from toads in the southern Rocky Mountains (FWS 1994d). This isolation is due to the physical and climatic characteristics of the Great Basin that are unsuitable for the species. Because of this isolation, possible genetic differences exist between toads in the southern Rocky Mountains and the remainder of the species range.

Historical records indicate that the boreal toad was once very common in Utah, especially in the northern part of the state (Ross et al. 1994). Museum records of boreal toads in Utah show their distribution in a range in elevation from about 4,508 feet to 10,289 feet above sea level (Ross et al. 1994). However, other data suggest that the lower elevational range for the boreal toad is 7,500 feet (FWS 1995a). For comparison, elevations within the SFN System impact area of influence are mostly below 5,000 feet. The boreal toad has largely disappeared from historical habitats in the Wasatch and Uinta Mountains of Utah.

Within the impact area of influence, the only documented records are two reported sightings from Goshen Bay, Utah Lake (Utah County) between 1978 through 1980 (Shields and Moretti 1982). Hovingh surveyed historical boreal toad locations around Utah Lake from 1989 to 1994, but did not observe the species. However, unpublished reports are available of boreal toads being common in Goshen Valley near White Lake and also occurring at Warm Springs, Spring Lake, and Payson Lakes (Willis 1994). Willis' observations are not supported by museum records, and the species was not observed during surveys of these areas in June and July 1994. Based on conflicting reports, the occurrence of boreal toads in the impact area of influence is considered possible but inconclusive at this time.

Pacific Chorus Frog. The Pacific chorus frog (*Pseudacris regilla*) has been identified by the State of Utah as a species of special concern (Utah Division of Wildlife Resources 1997a). It is chiefly a ground dweller, found among low plant growth near water in a variety of habitats, including grassland, chaparral, woodland, forest, desert oases and ditches, reservoirs, and slow streams. A few specimens exist from southeastern Washington County and unverified records have been reported from extreme northwestern Utah. The current status and distribution of this species remains unclear and it is not likely that the species occurs within the impact area of influence (Utah Division of Wildlife Resources 1997e).

3.7.5.1.2.5 Birds

Golden Eagle. The golden eagle is not a listed species or a candidate species for listing under ESA. However, it receives federal protection under the Eagle Protection Act, primarily because of its similarity of appearance to

bald eagles. It is also protected under provisions of the Migratory Bird Treaty Act (Littell 1992). Golden eagles are holarctic in distribution (Clements 1978) and are found in virtually all habitats of the western United States (Palmer 1988). With few exceptions, the breeding range of the species is unchanged from historical times (Harlow and Bloom 1987). Olendorff et al. (1981) estimated a wintering population of nearly 50,000 in the western states, and Braun et al. (1975) estimated a total population of 100,000 eagles for all of North America. During at least one recent year, the golden eagle population in Utah was reported to be increasing, although this may have been a temporary condition resulting from local increases in prey (Harlow and Bloom 1987). The species is relatively common throughout Utah and Juab Counties (Shields and Moretti 1982).

Surveys for nesting raptors in the Diamond Fork drainage area have been conducted annually since 1990 (Keller 1997). The surveys consisted of observing historical nest sites and potential cliff habitat for any activity within or adjacent to the site or for the presence of stick nests that would indicate active use. Five pairs of golden eagles are known to nest within Diamond Fork Canyon. Three pairs are located within 1.0 mile of areas in Diamond Fork Canyon where construction would occur. One pair has two nests near the Proposed Action and MCAPW-DFT Alternative Red Mountain Tunnel outlet portal. A second pair has seven to eight nests in the vicinity of Monks Hollow, and the last pair nests adjacent to Diamond Fork Road near Three Forks.

Northern Goshawk. There is concern that northern goshawk populations and reproduction may be declining in western North America (Reynolds et al. 1992). The primary factors responsible for these declines are believed to be human disturbance, loss of breeding and wintering habitat resulting from timber harvest, and reduced nesting success and reproductive failure resulting from pesticide contamination (Reynolds 1987). During winter, some goshawks at higher elevations descend to lower elevations into woodlands, riparian areas, and scrublands (Reynolds et al. 1992). In northern Utah, they nest in the upper Sonoran through the Hudsonian life zones, from about 5,700 feet to 8,100 feet above sea level (Reynolds 1987). Suitable nesting habitat for northern goshawks is absent from the impact area of influence. The species is an uncommon visitor to the impact area of influence during spring migration, but individuals have been observed at Mona Reservoir (Smith and Greenwood 1983b).

Ferruginous Hawk. The ferruginous hawk is considered to be declining throughout much of its range and to be common but declining in Utah (Harlow and Bloom 1987). Ferruginous hawks occur in grassland, sagebrush, and pinyon-juniper habitats, all of which are present in the impact area of influence. Information on the number of ferruginous hawks in Utah and their distribution is generally lacking, but they are considered to be a common spring and summer resident (Shields and Moretti 1982). In one study, ferruginous hawk was found to be the most common raptor species nesting within central Utah (Smith and Murphy 1973). Nesting has been documented in junipers on the west side of Utah Lake, but no reports of nesting within the impact area of influence were discovered. Marginal nesting habitat is provided in the juniper, sage, and grassland habitats in the area. Individuals are known to forage occasionally in grassland and agricultural areas within the impact area of influence.

Western Burrowing Owl. In the western United States, populations of the western burrowing owl have been locally affected by the loss of habitat resulting from the conversion of grasslands and grazing. The species is found at low elevations. The Utah Division of Wildlife Resources identifies the species as a summer nesting resident in southern Utah and eastern Juab Counties, but no recorded nesting sites are reported within the impact area of influence (Robinette 1995). The closest recorded nesting site is located west of Utah Lake near State Route 68 (Robinette 1995). No comprehensive survey efforts have been conducted in the impact area of influence for the western burrowing owl, but two adult burrowing owls have been consistently observed near Burraston Ponds over the last few years (Division of Wildlife Resources 1997c).

Short-Eared Owl. The short-eared owl (*Asio flammeus*) is a permanent resident of central and northern Utah wetlands and deserts. The species appears to be declining and is listed by the State of Utah as a species of special concern (Utah Division of Wildlife Resources 1997a). The short-eared owl is known to nest near Utah Lake.

Western Least Bittern. The western least bittern has been adversely impacted by the loss of freshwater marsh habitat throughout the western United States. The breeding range of the western least bittern extends from southern Oregon to southern California and southwestern Arizona (Palmer 1976). The subspecies winters primarily in Baja California and Mexico, and some individuals may winter as far south as central Peru (Palmer 1976). Records of occurrence are available from most western states, including northern Utah (Palmer 1976). However, there are no records for the SFN System impact area of influence. No bitterns were observed during habitat reconnaissance surveys of the Benjamin Slough and Goshen Bay areas of Utah Lake during summer 1994 (Utah Division of Wildlife Resources 1994d).

White-Faced Ibis. Habitat destruction and wetland drainage have led to the disappearance of the white-faced ibis in many historical nesting colonies in the western United States. Populations may also be adversely affected by pesticide residues (Capen 1977). The breeding range of the ibis extends from northern Utah and California south to southern Mexico. They winter from central California south to southern Texas and Mexico (Cogswell 1977). At least 25,000 ibis have been reported in the Rocky Mountains/Great Basin region (Voeks and English 1981). For many years, ibis have been reported to forage in wet meadows around Utah Lake (Pritchett et al. 1981), but breeding was not documented until 1971, when a large colony was discovered in Provo Bay (Kaneko 1972). The species is now considered to be relatively common in suitable habitat throughout the impact area of influence during the summer, and local annual breeding occurs. For example, flocks as large as 734 birds have been observed feeding in flooded alfalfa fields south of Powell Slough, and numerous other flocks containing from 100 to over 500 birds have been recorded in the vicinity of Provo Bay and Goshen Bay (Shields and Moretti 1982).

Western Snowy Plover. The population of western snowy plover that breeds along the Pacific Coast from Washington south to Baja California (Pacific Coast population) was listed as threatened under ESA in 1993 (FWS 1993a). Many birds from the interior population west of the Rocky Mountains winter on the Pacific Coast; however, these two populations are genetically isolated from each other (FWS 1993a). The principal threats to western snowy plover populations are loss of nesting habitat, predation, human activity in nesting colonies, disease, and trampling of nests by livestock and humans (FWS 1993a).

Western snowy plovers are considered uncommon in northern Utah, although large flocks have been observed at the Great Salt Lake (Behle et al. 1985). Snowy plovers breeding in Utah are migratory and winter around the Gulf of California and the west coast of Baja California (Paton 1994). The primary concentration areas are located around the Great Salt Lake (Division of Wildlife Resources 1994d), although suitable nesting habitat may occur on saline playas at scattered locations in the impact area of influence (such as Goshen Bay and Benjamin Slough). Huener et al. (1994) reported adults with young on dry playas south of Goshen Bay in July 1994. Populations in Utah appear to be stable (Division of Wildlife Resources 1994d).

Black Tern. The black tern has been adversely affected by drainage of freshwater marshes and bioaccumulation of pesticides (Cogswell 1977). It breeds from southern Canada to southern California, central Nevada, Colorado, Utah, and much of the northeastern United States (Cogswell 1977). The species winters on the ocean off western and northeastern South America and on major rivers there and in Africa. Black terns are considered uncommon in Utah (Utah Ornithological Society 1994). Black terns were not observed during habitat reconnaissance surveys of the Benjamin Slough and Goshen Bay areas around Utah Lake in the summer of 1994 (Division of Wildlife Resources 1994d).

Loggerhead Shrike. The Utah population of the loggerhead shrike is no longer included on the FWS list of candidate species for listing under ESA (FWS 1994g). Migrant shrike populations elsewhere in the United States continue to be designated as Category 2 candidate species. The breeding and wintering range of these birds extends from southern Canada to southern Mexico (Clements 1978). In central Utah, loggerhead shrike are considered to be year-round residents and occur in suitable habitat throughout the impact area of influence (Shields and Moretti 1982; Smith and Greenwood 1983b). Loggerhead shrike occupies open country such as the sagebrush

and pinyon-juniper habitats in Utah. Shields and Moretti (1982) noted shrikes in five habitats near Utah Lake: deciduous woodland, tamarisk, shadescale, greasewood, and sagebrush.

Swainson's Hawk. The State of Utah has identified Swainson's hawk (*Buteo swainsonii*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This neotropical migratory raptor nests in trees near open desert grasslands, shrub-steppes, and agricultural fields, primarily but not exclusively, in the northern valleys and west deserts of Utah. While Swainson's hawk populations in Utah have declined from historical levels, the species has exhibited a population increase in Utah and across its range during the period from 1966 to 1994. However, pesticide poisonings of tens of thousands of Swainson's hawks have occurred since 1994 in Argentina where at least a portion of Utah's population winters. The species is known to nest in the impact area of influence.

Caspian Tern. The State of Utah has listed the Caspian tern (*Sterna caspia*) as a species of special concern (Utah Division of Wildlife Resources 1997a). The species nests colonially on Great Salt Lake wetlands, islands, and dikes and occasionally on similar habitat in Utah Lake.

Common Yellowthroat. The State of Utah has listed the common yellowthroat (*Geothlypis trichas*) as a species of special concern (Utah Division of Wildlife Resources 1997a). The population of this species has declined significantly in Utah. This neotropical migrant nests in riparian and wetland habitats statewide. According to a bird survey report prepared for the Uinta National Forest, this species inhabits the herbaceous wetland/willow interface and is therefore most likely to occur in the lower part of Diamond Fork Canyon near the entrance marshes. The species was absent during the 1996 censuses but had been reported previously (Uinta National Forest 1996).

Yellow-Breasted Chat. The State of Utah has listed the yellow-breasted chat (*Icteria virens*) as a species of special concern (Utah Division of Wildlife Resources 1997a). Chat populations have declined in northern and southern Utah and throughout much of the West. This neotropical migratory species nests in dense riparian thickets of lower valleys and canyons. Surveys conducted in the lower Diamond Fork Canyon in 1996 found the yellow-breasted chat to be most abundant in campgrounds in the Brimhall area that provide mature cottonwood forests with shrub understory. Because the species is also positively associated with cottonwood/willow recruitment stands, it was found in moderately high numbers at the constructed wetlands and the agricultural fields in lower Diamond Fork Canyon (Uinta National Forest 1996).

American White Pelican. The State of Utah has listed the American white pelican (*Pelecanus erythrorhynchos*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This species nests in a large colony on Gunnison Island in the Great Salt Lake (and formerly on Utah Lake) but forages in freshwater wetlands and lakes. The nesting colonies in Utah are among the largest in North America and account for a significant proportion of the North American population (Utah Division of Wildlife Resources 1997a).

Sage Grouse. The State of Utah has listed the sage grouse (*Centrocercus urophassianus*) as a species of special concern (Utah Division of Wildlife Resources 1997a). The species has been noted in large expanses of sagebrush where they breed, nest, feed, and find cover. Sage grouse populations have declined across the range of the species, including Utah. Since 1967 in Utah, the abundance of male grouse attending breeding grounds has declined by approximately 50 percent. Brood counts and harvest data show a similar downward trend. Historically, the range of sage grouse in Utah was nearly continuous, including portions of all 29 counties. Currently, sage grouse exist in scattered populations in only 19 counties. Within the impact area of influence, sage grouse use the area surrounding lower Currant Creek (downstream of Mona Reservoir).

Long-Billed Curlew. The State of Utah has listed the long-billed curlew (*Numerius americanus*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This neotropical migrant shorebird nests in the upland meadows and rangelands of northern and central Utah valleys. It forages in moist meadow wetlands and

upland habitats. The species' range has been substantially reduced and current information indicates the population is declining regionally (Utah Division of Wildlife Resources 1997a).

Grasshopper Sparrow. The State of Utah has listed the grasshopper sparrow (*Ammodramus savannarum*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This neotropical migratory species was considered historically abundant in the state. Currently, only a few grasshopper sparrow breeding sites are known from northern Utah grasslands. Much of this species' former habitat has been lost to overgrazing and agricultural and urban encroachment. The species has declined significantly across its range. These birds nest in semi-colonial groups in dry grasslands characterized by short to mid-height clumps of grass with few to no shrubs.

3.7.5.1.2.6 Mammals

Pygmy Rabbit. In the western United States, populations of the pygmy rabbit (*Brachylagus idahoensis*) have been locally affected by the loss of habitat resulting from the conversion of brushlands to agriculture or grasslands for cattle grazing. The pygmy rabbit is distributed throughout the Great Basin. The UNHP has records for Beaver and Box Elder Counties but none for Utah or Juab Counties. The impact area of influence is within the range of the species, but contains only small amounts of marginal habitat, primarily within the foothill sagebrush communities that border the impact area of influence.

Spotted Bat. The spotted bat is widely distributed throughout western North America from southwestern Canada to Mexico. The species is believed to be rare throughout its range with minor exceptions. In Utah, the distribution of spotted bats is scattered from Salt Lake City south to the Utah-Arizona border. Known distribution in Salt Lake and Utah Counties is limited to single collections from both counties. Although suitable cliff roosting sites may occur in the Loafer Mountain area and other rocky habitats in the impact area of influence (Stone 1994), no sightings or collections have been documented (Toone 1991, 1992).

Fringed Myotis Bat. In the western United States, the fringed myotis bat occurs throughout most of the Intermountain West region except for an area encompassing western Wyoming, southeastern Idaho, and northern Utah (Zeveloff 1988). No recorded nesting or roosting locations have been reported in the impact area of influence (Utah Division of Wildlife Resources 1995). Population decline has been primarily attributed to direct disturbance of nursery habitat or loss of nesting and roosting sites. No decline has been attributed to loss of foraging habitat.

Long-Eared Myotis Bat. The long-eared myotis bat is a western species whose range occupies the entire Intermountain West region, with the possible exception of some areas in far southeastern Nevada (Zeveloff 1988). Similar to other bat species, its population declines have been attributed to loss and disturbance of nesting and roosting habitat. No recorded nesting or roosting locations have been reported in the impact area of influence (Utah Division of Wildlife Resources 1995).

Long-Legged Myotis Bat. The long-legged myotis bat occurs throughout western North America, including the entire Intermountain West (Zeveloff 1988). Its primary distribution includes Utah and Nevada. Similar to other bat species, its population declines have been attributed to loss and disturbance of nesting and roosting habitat. No recorded nesting or roosting locations have been reported in the impact area of influence (Utah Division of Wildlife Resources 1995).

Small-Footed Myotis Bat. The small-footed myotis bat is distributed throughout the western United States, except for northern Pacific coastal areas. It occurs throughout the Intermountain West. As with the other bat species, population declines have been primarily attributed to direct disturbance of nursery habitat or loss of nesting and roosting sites. No recorded nesting or roosting locations have been reported in the impact area of influence (Utah Division of Wildlife Resources 1995).

Pale Townsend's Big-Eared Bat. The pale Townsend's big-eared bat (also known as the western big-eared bat) is perhaps the most common big-eared bat in most of the western United States. This bat is common in the highlands of the West, often found in scrub plant communities as well as pine, pinyon/juniper, and deciduous forests. Although it occurs in deserts, it is generally uncommon in dry regions (Zeveloff 1988). No recorded nesting or roosting locations have been reported in the impact area of influence (Utah Division of Wildlife Resources 1995).

Allen's Big-Eared Bat. The distribution of Allen's big-eared bat (*Idionycteris phyllotis*) appears to be widely distributed throughout the lower two-thirds of Utah (Utah Division of Wildlife Resources 1997a). This may have changed in the past 50 years. According to the Utah Division of Wildlife Resources (1997a), there may have been changes in its numbers and habitat; studies need to be conducted to determine current distribution.

North American Wolverine. No comprehensive surveys have been conducted for the North American wolverine in the impact area of influence, and the Department of Natural Resources' databases reflect this in the limited number of recorded observations (Utah Division of Wildlife Resources 1995). Within the general vicinity of the impact area of influence, the last sighting was in the high elevation areas of the Uinta Mountains in the late 1970s (Robinette 1995).

North American Lynx. The North American lynx ranges widely over the forested areas of Canada and northern latitudes of the conterminous United States. A few unverified reports of lynx have been received from the extreme northeastern part of Utah.

3.7.5.1.2.7 Reptiles

Utah Mountain Kingsnake. The State of Utah has listed the Utah mountain kingsnake (*Lampropeltis pyromelana infralabialis*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This colorful tri-colored snake occurs in disjunct, localized populations in many of the central Utah mountain regions. Its habitat includes chaparral woodland and pine forests in mountainous regions and bushy rocky canyons, talus slopes, and near streams and springs above 2,800 feet. Population declines, although difficult to detect in this secretive species, are thought to be due to habitat impacts and overcollection. This species is unlikely to occur in the impact area of influence.

Utah Milk Snake. The State of Utah has listed the Utah milk snake (*Lampropeltis triangulum taylori*) as a species of special concern (Utah Division of Wildlife Resources 1997a). Often nocturnal, this species inhabits semi-arid regions, pine forests, deciduous woodlands, and suburban areas. It is spottily distributed in the mountain regions of eastern and central Utah. With the species being attractive to snake fanciers, overcollection, as well as habitat impacts, may be factors in its apparent decline. This species is likely to occur in the impact area of influence.

3.7.5.2 No Action Alternative

The affected environment for the No Action Alternative for special-status species is limited to species identified in Section 3.5.7.1 that occur or could be located within the Diamond Fork drainage area or within the Spanish Fork River and its riparian corridor.

3.7.6 Impact Analysis

3.7.6.1 Potential Impacts Eliminated from Further Analysis

The following species were eliminated from further analysis because either the species or suitable habitat for the species does not occur within the impact area of influence: Deseret milkvetch, Garrett bladderpod, Tidestrom's beardtongue, Eureka mountainsnail, Pacific chorus frog, North American wolverine, North American lynx, and Utah mountain kingsnake.

3.7.6.2 Significance Criteria

This section describes the criteria used to determine the magnitude of impacts resulting from the Proposed Action and alternatives. For consistency in use of terms in this document, the terms *significant* and *not significant* are used to describe the magnitude of individual impacts, even though it is recognized that the FWS has sole authority to determine impacts on threatened and endangered species. As noted below, specific significance criteria were developed for two species because sufficient data existed from which the criteria could be developed.

3.7.6.2.1 Ute Ladies'-Tresses. The following significance criteria were used to determine the impacts to Ute ladies'-tresses. Any loss or conversion of occupied Ute ladies'-tresses habitat to unsuitable habitat as a result of construction activities or the coordinated operation of the Diamond Fork and SFN Systems is considered a significant impact for purposes of this National Environmental Policy Act (NEPA) document. An occupied habitat is considered converted to an unsuitable habitat if one of the criteria listed below is predicted to occur:

- **Criterion 1:** The magnitude of channel forming (2-year and 5-year flood flows) is reduced to more than 18 inches below the ground surface of occupied habitat.

- **Criterion 2:** Soil moisture conditions were characterized by exceedence flow comparison between baseline and post project hydrological conditions in the Diamond Fork drainage. For the Spanish Fork River, an average August river water surface elevation being reduced 18 inches below the occupied habitat was used.

- **Criterion 3:** The duration of inundation increases by more than 14 days during the growing season (June through October) or by more than 7 days during any single month of the growing season.

- **Criterion 4:** The occupied habitat is covered by fill or the soil is removed during construction or the habitat is permanently inundated.

These criteria are based upon the specific habitat and hydrologic data collected for the occupied habitats along the Spanish Fork River and Diamond Fork Creek. They are applied to each colony along the Spanish Fork River and Diamond Fork Creek to address the potential effects of reduced habitat maintenance and opportunities for recruitment (Criterion 1), reduced soil moisture through reduced flows (Criterion 2), anoxic soil conditions as a result of increased flows (Criterion 3–Spanish Fork River only), or direct soil disturbance (Criterion 4–Spanish Fork River only).

3.7.6.2.2 Least Chub. The following significance criteria were used to determine the impacts to least chub:

- A direct or indirect loss of any physical habitat available to this species occurs within the impact area of influence

- Water temperature exceeds 10 percent of existing habitat temperature range or a maximum of 90°F

- April through July water temperatures fail to reach 60°F to initiate spawning
- Aquatic vegetation density is reduced to less than moderate levels
- Loss of low to moderate current habitat is qualitatively estimated to be greater than 20 percent
- Salinity exceeds 2,000 ppm TDS (a generic safe limit for most fish) for more than 30 days
- Mosquitofish are actively stocked into least chub habitat
- Bass, trout, catfish, or any other potential predator fish is introduced directly or indirectly into least chub habitat

3.7.6.2.3 Species of Special Concern. Impacts to species of special concern were evaluated for significance based on the following criteria:

- Impacts to listed threatened and endangered species, or species proposed for such listing, that result in any mortality or loss or adverse modification of critical habitat as designated under the ESA or that conflict with the objectives of an official recovery plan for the species.
- Impacts to non-listed species of special concern or the habitat for these species that result in substantial population reductions. "Substantial" reductions are considered to be those that would destroy a large area of utilized habitat, disturb or displace a resident population (sub-population), or result in losses of large numbers of individuals of the species.

3.7.6.3 Proposed Action

The following sections describe the potential impacts to threatened, endangered, and species of special concern as a result of construction and operation of the Proposed Action and related actions (local development).

3.7.6.3.1 Construction Impacts

3.7.6.3.1.1 Plants. No Ute ladies'-tresses colonies are located within the alignment of the "Diamond Fork Tunnel Alternative." The route for the Main Conveyance Aqueduct would remain outside of the Spanish Fork River until it crosses the Spanish Fork River below the Strawberry Diversion Dam. No Ute ladies'-tresses colonies are located within the alignment in the Spanish Fork Canyon. Therefore, there would be no direct construction impacts to the Ute ladies'-tresses under the Proposed Action.

3.7.6.3.1.2 Fish. Under the Proposed Action, the "Diamond Fork Tunnel Alternative" requires the construction of two siphons, two tunnels, and a pipeline in the Red Hollow drainage upstream of the existing Diamond Fork Pipeline. Construction of the Sixth Water Siphon on Sixth Water Creek and the Diamond Fork Siphon on Diamond Fork Creek above Three Forks would require the excavation of soil and rock near and across the streambed of these two creeks. Construction of the Red Hollow Pipeline would also disturb soil that could eventually enter Diamond Fork Creek through ephemeral and intermittent tributary streams. The disturbed soil has the potential to enter Sixth Water and Diamond Fork Creeks during storm events and, if in sufficient quantity, to degrade habitat for invertebrates and fish through sedimentation.

The construction staging areas constitute other potential sources of sediment input and chemical contaminants. A 6-acre staging area for the Diamond Fork Siphon would be located on a flat along Diamond Fork Creek about 0.6 mile upstream of Monks Hollow. A 2-acre staging area for the Tanner Ridge Tunnel outlet would be located

on a flat near Diamond Fork Creek above Three Forks, and a new 0.3-mile access road to the Red Mountain Tunnel outlet would disturb 2 acres of land on the flats at the upper end of Red Hollow. Adhering to the best management practices for construction procedures (described previously in Chapter 1 and Appendix B, *Standard Operating Procedures*), would prevent excessive input of sediment from these sources of disturbed soil as well as the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures reduce the risk for these types of construction-related fishery impacts to insignificant levels.

The instream excavations for the siphons would minimize the potential for excessive sedimentation by using coffer dams and limiting instream construction activities to base flow conditions of 7 to 9 cfs for Sixth Water Creek (late October shutdown of Syar Tunnel for maintenance) and less than 3 cfs for Diamond Fork Creek above Three Forks. Additionally, following the best management practices for construction procedures would prevent excessive input of sediment and the inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints, and freshly poured concrete. These preventative measures reduce the risk for construction-related fishery impacts to insignificant levels.

Construction of the Tanner Ridge Tunnel and Red Mountain Tunnel would create rock waste materials that would be removed from the immediate vicinity of the tunnel portal and properly disposed in a manner to prevent sediment input to adjacent drainages.

No construction activities would occur in the vicinity of the Burraston Ponds wetlands complex containing least chub. No facilities or staging areas would be located along the Spanish Fork River above or below the Strawberry Diversion Dam. The pipeline crossing of the Spanish Fork River would adhere to the construction procedures outlined in Chapter 1 and Appendix B, *Standard Operating Procedures*. No direct impacts to aquatic resources would result from improvements to on-farm systems or the construction of the M&I Distribution System. As a result of the Proposed Action, construction of the Lateral 20 distribution pipeline would cross Spring Creek and could potentially impact leatherside chub and other native non-game fish through erosion and sedimentation. However, this would be avoided by adherence to the construction procedures noted in Chapter 1. As such, there would be no significant impacts to special-status fisheries from construction activities.

3.7.6.3.1.3 Invertebrates. Invertebrate species, including the Utah hydroporus diving beetle, Utah valvata snail, Utah physa, and thickshell pondsnail, all require spring-fed, open water/aquatic beds habitat. This type of habitat exists within the proposed Main Conveyance Aqueduct right-of-way, but is limited to an emergent marsh located at the western edge of Cold Springs in Spanish Fork Canyon. This area would be restored following construction. As a result, construction of the Proposed Action would not significantly affect these species. In addition, although suitable habitat for the California floater is present within the impact area of influence near Burraston Ponds, construction activities would not adversely impact this habitat.

3.7.6.3.1.4 Amphibians. The impact of construction activities on the spotted frog is similar to that discussed for the invertebrate species. The spotted frog is highly aquatic and prefers cool, clear, spring-fed ponds with an organic substrate. Construction of the Proposed Action would not result in any permanent loss of aquatic habitat that could be used by this species. Short-term disturbance of emergent vegetation would occur at the Cold Springs pond, but this area was surveyed with negative results. Construction activities would have no effect on the locations where the species was found during recent surveys. As a result, construction of the Proposed Action would not adversely affect the species, and the potential impact is not significant.

Similar to the spotted frog, the western boreal toad also inhabits aquatic habitats. The presence of boreal toads in the SFN System impact area of influence in substantial numbers is debatable since evidence exists that the impact area of influence lies below the lower elevational range of the species. However, assuming that the species does exist in the impact area of influence, construction activities under the Proposed Action would not result in any permanent loss of aquatic habitat that could be used by this species. Short-term disturbance of aquatic vegetation

and temporary disturbance of a small amount of upland habitat adjacent to aquatic habitats would affect only a small percentage of the potential aquatic habitat available to boreal toads within southern Utah and eastern Juab Valleys. These impacts are not considered significant as they would not adversely affect the continued existence of the western boreal toad in the impact area of influence (if they do exist).

3.7.6.3.1.5 Birds

Bald Eagle and Golden Eagle. Construction of the "Diamond Fork Tunnel Alternative" under the Proposed Action would likely disturb golden eagle nesting near the site of the proposed Red Mountain Tunnel outlet portal. Construction activities, including blasting, within 1.0 mile of golden eagle nest sites would increase the potential for nest abandonment, loss of eggs and young, and a resulting short-term decline in the recruitment of the local population. Temporary reductions in the local prey base could also occur during construction. Construction impacts on golden eagle foraging habitat are not considered significant as the duration of the impacts would be short-term and higher value foraging habitat is available throughout the region. The CUWCD would coordinate with the FWS and Utah Division of Wildlife Resources to obtain necessary permits and comply with all conditions of the permits issued.

The Spanish Fork River and areas along the Main Conveyance Aqueduct alignment and facilities are not known roosting or concentration areas for bald eagles, and higher value habitat is abundant in the region. However, some winter foraging habitat for bald eagles along the Spanish Fork River may be temporarily affected by construction activities. Approximately 5 miles of the Main Conveyance Aqueduct alignment runs adjacent to the Spanish Fork River, which provides limited foraging habitat for eagles during winter. Some temporary and permanent loss of upland foraging habitat for golden eagles may also result from construction activities. However, construction impacts on bald eagle foraging habitat are not considered significant as very few individuals would be affected, the duration of the impacts would be short-term, the Spanish Fork River is not a critical foraging or roosting area, and higher value foraging habitat is available throughout the region.

Peregrine Falcon. Construction activities associated with the Proposed Action would have no direct or indirect impacts on breeding peregrine falcons as no nesting territories have been active in the region for over 25 years (Shields and Moretti 1982). Foraging activity of peregrines would also not be affected by construction activities. Because peregrines are primarily aerial predators, important foraging areas are usually located near wetlands that support large concentrations of birds, especially waterfowl and shorebirds. No important foraging habitat would be disturbed during construction, and no impacts on peregrines are anticipated.

Northern Goshawk. Construction of the Proposed Action would have no direct or indirect effect on breeding northern goshawks because suitable breeding habitat is absent in the impact area of influence. Limited foraging opportunities are available for a small number of goshawks that are observed infrequently near Mona Reservoir during winter, and forested habitat preferred by the species does not exist. As a result, the impact area of influence does not provide important habitat for the species, and any impacts associated with project construction would not be significant.

Ferruginous Hawk. While this species is known to forage on an irregular basis in grassland and agricultural areas within the impact area of influence, ferruginous hawk nesting habitat is limited, primarily because of increasing levels of agricultural conversion and urban development. Nesting has been reported within juniper/sage habitats on the west side of Utah Lake but not within the impact area of influence (Shields and Moretti 1982). As a result, construction activities would not impact breeding ferruginous hawks. Impacts of project construction on foraging habitat for the species would be the same as those described above for golden eagles and are considered not significant.

Yellow-Billed Cuckoo. Although suitable nesting and foraging habitat exists, the yellow-billed cuckoo is considered an uncommon summer visitor in the impact area of influence, with the most recent recorded sighting

occurring in 1973 in Santaquin. A recent neotropical bird survey conducted by the Uinta National Forest (1996) did not report occurrence of this species in lower Diamond Fork Creek. Construction of the Main Conveyance Aqueduct is not expected to have a significant impact on this species as the crossing of the Spanish Fork River by the Main Conveyance Aqueduct does not occur within suitable potential habitat for the species.

Western Burrowing Owl. The burrowing owl would likely not be present along the alignment of the "Diamond Fork Tunnel Alternative" nor along the portion of the Main Conveyance Aqueduct alignment within Spanish Fork Canyon. Because suitable habitat is absent, it is also not likely to be found in the frequently disturbed agricultural lands where the Main Conveyance Aqueduct would be constructed near Nephi. Given the character of the habitat along the I-15 corridor, however, the owl could be present in the sagebrush communities within this area; the Utah Division of Wildlife Resources (1997c) has reported observations of two adult burrowing owls near Burraston Ponds.

Construction of the Proposed Action and related actions (local development) would disturb only a narrow corridor along the Main Conveyance Aqueduct alignment and at limited areas at the related facilities. The majority of the disturbed habitat would be revegetated, with the exception of the recreation trail. Overall, the potential for the species to be present is considered low, and the likelihood that construction would adversely affect the species is also considered low.

Western Least Bittern. Suitable freshwater marsh habitat for western least bittern does not occur near the area to be disturbed by construction activities. As a result, construction activities associated with the Proposed Action would have no effect on this species.

White-Faced Ibis. Construction of the Proposed Action would not affect large wetland and irrigated pasture habitats preferred by white-faced ibis for nesting and feeding. As a result, no impacts to the species are expected as a result of construction activities.

Western Snowy Plover. Saline playas used as nesting and foraging habitat for the western snowy plover are absent from the Main Conveyance Aqueduct alignment and would not be disturbed during construction. As a result, construction of the Proposed Action would have no effect on the species.

Black Tern. Black terns prefer large (greater than 10 acres) freshwater marshes. Suitable habitat does not occur in the Main Conveyance Aqueduct corridor, and construction of the Proposed Action would have no effect on the species.

Loggerhead Shrike. Shields and Moretti (1982) recorded loggerhead shrike in five habitats near Utah Lake: deciduous woodland, tamarisk, greasewood, shadescale, and sagebrush. The Utah population of the loggerhead shrike is no longer included on the FWS list of candidate species for listing under ESA (FWS 1994g). Migrant shrike populations elsewhere in the United States continue to be designated as a species of special concern (FWS 1995c). Western breeding bird surveys indicate significant declines throughout the species' range; however, the causes of these declines are not clear. Although suitable nesting habitat is limited in the Main Conveyance Aqueduct right-of-way, clearing of trees and brush during the nesting season could destroy any nests, eggs, and young that may be present. These impacts are not considered significant as few individuals would be affected and suitable nesting and foraging habitat for shrike is abundant throughout central Utah.

Swainson's Hawk. Construction activities associated with the Proposed Action could potentially disturb Swainson's hawks nesting up to 1 mile from the proposed facilities. However, the majority of these facilities are near existing residential communities, highways, railroads, and other sources of disturbance that deter raptors from nesting. If active Swainson's hawk nests are located near any of the Proposed Action facilities, construction disturbance would increase the potential for nest abandonment, loss of eggs and young, and a resulting short-term decline in recruitment to the population. However, the potential for short-term declines in productivity would not

be a significant impact as the species would recover the following season in the absence of other environmental perturbations. Temporary reductions in the prey-base could also occur during construction, but the impact would not be significant as the loss of prey would be short term and restricted to the construction sites and would represent a fraction of the prey available to the species in southern Utah and eastern Juab Counties.

Caspian Tern. Construction of the Proposed Action would not affect large wetland habitat preferred by the Caspian tern for nesting and feeding. As a result, no impacts to the species are expected to occur as a result of project construction.

Common Yellowthroat. Construction of the Proposed Action would not affect large wetland habitat preferred by the common yellowthroat for nesting and feeding. As a result, no impacts to the species are expected to occur as a result of project construction.

Short-Eared Owl. The short-eared owl would not likely be present along the alignment of the "Diamond Fork Tunnel Alternative" nor along the portion of the Main Conveyance Aqueduct alignment within Spanish Fork Canyon. Because suitable habitat is absent, it is also not likely to be found in the frequently disturbed agricultural lands where the Main Conveyance Aqueduct would be constructed near Nephi. Construction of the Proposed Action and related actions (local development) would disturb only a narrow corridor along the Main Conveyance Aqueduct alignment and at limited areas at the related facilities. The majority of the disturbed habitat would be revegetated, with the exception of the recreation trail. Overall, the potential for the species to be present is considered low, and the likelihood of project construction to adversely affect the species is also considered low.

Yellow-Breasted Chat. Construction of the Proposed Action would not affect mature cottonwood forest habitat preferred by the yellow-breasted chat for nesting and feeding. As a result, no impacts to the species would occur as a result of project construction.

American White Pelican. Construction of the Proposed Action would not affect large wetland habitat preferred by the American white pelican for nesting and feeding. As a result, no impacts to the species are expected to occur as a result of project construction.

Sage Grouse. Construction of the Currant Creek distribution pipeline as part of the related actions (local development) would occur in the habitat used by the sage grouse. However, the distribution pipeline would be constructed primarily in the narrow right-of-way immediately adjacent to the existing road and is therefore not expected to have a significant impact on sage grouse habitat occurring near lower Currant Creek.

Long-Billed Curlew. Construction of the Proposed Action would not affect large wetland habitat preferred by the long-billed curlew for nesting and feeding. As a result, no impacts to the species are expected to occur as a result of project construction.

Grasshopper Sparrow. Construction of the Proposed Action would not affect the dry grassland habitat preferred by the grasshopper sparrow. As a result, no impacts to the species are expected to occur as a result of project construction.

3.7.6.3.1.6 Mammals

Pygmy Rabbit. Pygmy rabbits prefer dense stands of sagebrush on deep, friable soils. Construction of the Proposed Action would result in temporary disturbance of 589 acres and some permanent loss of sagebrush/grass habitat. However, no pygmy rabbits have been reported within the region in recent years. As a result, construction activities under the Proposed Action would have no effect on the pygmy rabbit.

Bats. Many of the bat species (e.g., spotted bat, fringed myotis, long-eared myotis, long-legged myotis, and small-footed myotis) roost primarily in crevices on cliffs and other rocky areas, and suitable habitat exists at various locations near the impact area of influence. The pale Townsend's big-eared bat, common in pine, pinyon/juniper, and deciduous forests, roosts in similar habitat as other related bats. Construction activities, including blasting, near Loafer Mountain and other rocky locations could disturb potential bat roosting habitat; however, since no occurrences of this or any of the other subject bat species have been reported within the impact area of influence (Utah Division of Wildlife Resources 1995), construction of the Proposed Action would not adversely affect these species.

3.7.6.3.1.7 ***Reptiles***. Clearing and grading activities associated with the construction of the Proposed Action could disturb the Utah milk snake. However, no denning sites are known to exist within the rights-of-way required by the Proposed Action. In addition, open trenches could create a temporary hazard and be a barrier to the snake's movements. Implementation of the standard operation procedures referenced in Appendix B, *Standard Operating Procedures* (i.e., covering or backfilling open trenches at the end of the day and inspecting for trapped animals before doing so) would reduce the likelihood of this impact.

3.7.6.3.2 Operation Impacts

3.7.6.3.2.1 Plants

Diamond Fork Creek. As a result of the Proposed Action, the flows in Diamond Fork Creek would be stabilized at approximately 60 cfs during the winter months (October through March), 88 cfs in April, and 80 cfs in August and September. June and July flows would be reduced to 128 cfs and 106 cfs, respectively, from baseline flows of 271 and 293 cfs. For Diamond Fork Creek, a separate analysis was made on the changes in hydrology comparing baseline to the Proposed Action (EPT 1997).

This analysis provides a characterization of changes in hydrology as a result of changing the operation of flows in Diamond Fork Creek from baseline conditions (i.e., those historically present in the canyon) to a proposed preferred alternative flow regime. This change in flow characterization, and the following analysis, provides data for performing an impact analysis for the Ute ladies'-tresses population in the canyon, as is known to have existed in 1994. Methodology for this flow change characterization has differed from the methods used in the 1995 Biological Assessment prepared for ESA Section 7 Consultation with the FWS. The proposed methods for analyzing potential impacts to the Ute ladies'-tresses were addressed in a letter dated December 16, 1997, from the Field Supervisor for the Utah field office of the FWS (FWS 1997).

In the field and on 2-foot contour maps of the Diamond Fork Canyon, nine transect pairs (one set of transects from Boyle Engineering and one set from Craig Adley) were located in close proximity, modeling similar channel morphology. The flow exceedence analysis was performed on all 18 transect locations. For academic purposes, it was supposed that these were at colony locations (in most cases they were not). The analysis was completed to the end, estimating to what degree the proposed change in flow regime had to impact the colonies at each transect. The results of the pairs were matched up and in every case, the results were the same for each transect pair. It is assumed, therefore, that even though the Boyle transects may not have been field surveyed at every location, they modeled existing conditions closely enough to produce analysis results similar to those resulting from the field surveyed transects. The Boyle transects were therefore used as input for all subsequent flow exceedence analyses because they are located at known colonies.

It was first determined which of the Boyle cross sections were applicable to Ute ladies'-tresses impact analysis. Using the stage discharge curves, cross sections, and exceedence tables for those transects, it was determined what percentage of a month (April through October) the elevations of concern (mean elevation of the colony, 6 inches below mean elevation, 12 inches below mean elevation, and 18 inches below mean elevation) were exceeded for each of the colony locations known to be occupied in 1994. This was done for both the baseline flows and for

the proposed flows under the Proposed Action. The percentages were then converted to the number of days in the month (i.e., 50 percent = 15 days).

Exceedence values are interpreted to be the percent of the time period (in this analysis, 1 month from April through October) that a particular elevation of concern for a particular colony location is exceeded. The exceedence value under baseline flows was then compared to projected exceedence flows under the Proposed Action. The percentage change in these values was then determined. For example, the baseline exceeds that elevation at that location during any day in the month of October, and zero percent under the Proposed Action. However, the value for 18 inches below the mean elevation of that colony may be 80 percent, or 24 days (i.e., during 80 percent of the month of October, groundwater is at least 18 inches below the mean elevation of the colony) under the baseline flow regime, and 35 percent, or 10.5 days, under the Proposed Action flow scenario. The hypothetical scenario would suggest that the change in exceedence of this critical elevation would be 56 percent, or 16.8 days [(80-35)/80], which is to say that there would be a 56 percent reduction in the time that the particular critical elevation would be saturated or below water surface.

The analysis of the change in flows with the Proposed Action versus baseline conditions shows that there may be some unquantifiable adverse effect on occupied Ute ladies'-tresses habitat as well as the opportunity for creation of new habitat. However, there is no accepted methodology for determining the effects of these varying flow regimes, and the changes in stream elevation during the growing season are not consistently low. Therefore, it is not possible to quantify the potential adverse or enhanced effects to current occupied habitat or to quantify how much new habitat could be created.

Because the baseline condition of the currently occupied Ute ladies'-tresses habitat is nearly optimum, there could be a net reduction in occupied habitat under the Proposed Action. However, based on the exceedence flow analysis, it is expected that healthy, well-distributed colonies of the Ute ladies'-tresses would remain in Diamond Fork Canyon under the operation of the Proposed Action.

Spanish Fork River. Under the Proposed Action, the average August water surface elevation of four of the seven Ute ladies'-tresses colonies bordering the Spanish Fork River would remain within 18 inches of the August water surface elevation. The average August river water surface elevation would be reduced below 18 inches for Colonies 15-2, and 15-5, both located at Shurtz Canyon, thereby significantly affecting the quality of the habitat. Because Colony 15-1 is more than 18 inches above the August water surface and appears to be supported primarily by tributary seepage from Bow Valley Reservoir, the reduction in August river water surface would not likely convert this habitat to an unsuitable hydrologic condition. Under this hydrologic regime, the 2-year flood flow would continue to inundate the two colonies south of Cold Springs (Colonies 1 and 2; E.O. 14), but Colony 4 at Shurtz Canyon (E.O. 15), which requires a flow of 1,150 cfs to be inundated, would not be inundated by the 10-year flood flow. This would result in a potential long-term decline in this colony as a result of the lack of a scouring flow to maintain the habitat within the timing of the species' life history requirements.

Overall loss along the Spanish Fork River is estimated at 78 individuals and 1.1 acres of currently occupied habitat. This represents 15 percent of the maximum number of individuals observed during the 3-year survey period and 32 percent of the occupied habitat along the Spanish Fork River. However, all of the habitat affected is characterized as marginal because the colony either consists only of single individuals or the colony is actively being invaded by tamarisk. Because of the establishment of tamarisk throughout one of the colonies at Shurtz Canyon (Colony 15-5), this site would likely not remain suitable Ute ladies'-tresses habitat even in the absence of the SFN System.

3.7.6.3.2.2 Fish

Least Chub. A spring complex near Burraston Ponds contains a population of least chub. Water quality measurements of this spring complex by the SFN System study team in August and September 1994 revealed

electrical conductivities of 2,650 and 2,700 micromhos per centimeter (µmho/cm). The Proposed Action's estimated 11 percent salinity increase in upper Currant Creek springflow would result in a conductivity of 2,996 µmhos/cm. Lamarra (1981) reports that the range of conductivities in which the least chub were collected in the Snake Valley marsh complex to be 450 to 9,000 µmhos/cm. Therefore, the Proposed Action's 11 percent increase in salinity would have no significant impact on the least chub population on the west side of upper Currant Creek.

The spring complex exists at a slightly higher elevation than Currant Creek, and its outflow flows through a 12-inch culvert, then drops 5 feet to enter the creek. This upstream migration barrier has protected the least chub population of the spring complex from the invasion of exotic predator fishes such as bass, green sunfish, and yellow perch. These same conditions would continue to protect this population of least chub under the increased flow conditions of the Proposed Action and supports the goals of the least chub conservation agreement (Utah Division of Wildlife Resources 1997b).

Leatherside Chub. Sampling in the lower portion of Sixth Water Creek in 1994 and the upper portion in 1996 and 1997 failed to find leatherside chub. The extensive sampling of Diamond Fork Creek below Monks Hollow in 1996 found very few leatherside chub upstream of Brimhall Canyon. Therefore, this assessment of potential impacts to leatherside chub focuses on Diamond Fork Creek below Brimhall Canyon, the Spanish Fork River, and Spring Creek.

Diamond Fork Creek. The following categories of potential impacts to leatherside chub in Diamond Fork Creek have been identified: habitat loss, excessive predation by brown trout, and intolerable temperatures. The potential for each of these events to occur under the Proposed Action is evaluated below.

Habitat Loss. When surveyed in the fall of 1996, most of the leatherside chub in the 3.5 miles of Diamond Fork Creek below Monks Hollow were found in the cutoff pools and backwater habitats rather than in the main channel (Walser et al. 1997). Using basic habitat suitability indices created from the range of water depth and current velocity in which Wilson and Belk (1996) found leatherside chub in the Sevier River, the 1997 IFIM study generated Weighted Useable Area estimates of leatherside chub habitat for three stations representing primarily the main channel of Diamond Fork Creek between Monks Hollow and Highway 6. Suitable habitat for leatherside chub in the main channel was maximized by a flow of 35 cfs.

The Proposed Action would change the base flow in this reach from approximately 15 to 60 cfs. This would increase leatherside chub habitat in the main channel by 24 percent over baseline conditions. Under baseline conditions, the average summer flow for June through September is 223 cfs; under the Proposed Action, it would be 98 cfs. During this 4-month summer period, the Proposed Action would increase the leatherside chub habitat in the main channel to 25 percent over baseline conditions. Therefore, the Proposed Action would create a 24 to 25 percent improvement in main channel habitat available to leatherside chub.

However, most of the leatherside chub are presently using the vegetated cutoff pool habitats and backwaters, some of which are spring-fed and offer ice-free winter habitat (Belk 1997). Maintaining the existing numbers of leatherside chub in Diamond Fork Creek under the Proposed Action would require maintaining side channels and backwaters. Under the Proposed Action, the peak flow occurs in May. The mean flow in May is approximately half the mean peak flow (293 cfs in July) under baseline conditions. It is questionable whether the Proposed Action flows would maintain a sufficient quantity of cutoff pool and backwater habitats to support the present numbers of leatherside chub, as the number of braided channels would be reduced by riparian encroachment over a 10- to 20-year period. Because a long-term management goal for the creek is the restoration of the channel to a size more appropriate to its drainage area and projected streamflows, a certain amount of riparian encroachment and stream bank stabilization is necessary. The number of actively braiding channels would reduce over time, but an unknown quantity of cutoff pools and spring-fed backwaters would continue to exist and support a possibly reduced level of the existing population of leatherside chub.

Predation by Brown Trout. Walser et al. (1997) found most of Diamond Fork Creek's leatherside chub in the cutoff pool habitat and backwaters. Although the main channels of this reach contained moderate numbers of brown trout, very few trout of a size sufficient to prey on leatherside chub were found in the backwaters and cutoff pools where leatherside chub were abundant. Conversely, very few leatherside chub were found in the main channels where there was little cover to protect them from predation. The authors of the study suggested that predation by brown trout might be the reason that the leatherside chub were not more abundant in the main channel. This possibility was examined using the 1997 IFIM data generated by the nine transects used to model this river segment. The late fall and winter base flow in Diamond Fork Creek is 15 cfs under baseline conditions. The amount of leatherside chub habitat available in the main channel at 15 cfs is 6.5 times greater than the quantity of habitat available to adult brown trout. Making this same comparison with the 223 cfs average flow for June through September, an important period for fish growth, leatherside chub habitat is 117 percent of the adult brown trout habitat. Based on this comparison, it appears that brown trout predation may be the reason leatherside chub are rarely found in the main channel, although there is no shortage of suitable (relative to depth and velocity) leatherside chub habitat in the main channel.

The baseline condition trout population (87 percent brown trout) for this segment of Diamond Fork Creek is 70 pounds per acre. The Proposed Action is estimated to increase the trout standing crop to 247 pounds per acre. This increase in brown trout would tend to preclude leatherside chub from utilizing the main channel and continue to confine them to the shallow, vegetated cutoff pools and backwaters where they are most prevalent under baseline conditions. As noted above, maintaining the existing numbers of leatherside chub in Diamond Fork Creek under the Proposed Action would require maintaining these more isolated habitats.

Temperature. The baseline temperatures in Diamond Fork Creek below Monks Hollow for May through September range from 46°F to 66°F. When Strawberry Reservoir releases are from above the thermocline, Proposed Action temperatures for this same period in Diamond Fork Creek would range from a May low of 50°F to a July high of 67°F. With Strawberry Reservoir releases occurring from below the thermocline, the Proposed Action temperature range for May through September would be 47°F in May with the rest of the summer months averaging 49°F to 50°F.

Water releases from below the thermocline would not adversely affect leatherside chub populations in this portion of Diamond Fork Creek as Sigler and Sigler (1987) report this native minnow to be found in waters with summer temperatures ranging from 50°F to 74°F. The primary spawning trigger for this species appears to be temperature, with peak spawning occurring when monthly water temperatures average 49°F (Johnson et al. 1995). Although leatherside chub spawning in the Utah Lake drainage typically occurs in May, spawning may occur in other parts of its range from June to August. Should Diamond Fork Creek waters be released from above the thermocline at Strawberry Reservoir, leatherside chub spawning would continue to occur in May. Water releases from below the thermocline would result in the leatherside chub spawning in June (average predicted temperature of 49.3°F). Water releases from below the thermocline would result in a slower growth rate for leatherside chub than presently occurs.

Upper Spanish Fork River. Baseline temperatures for the period of May through September are 54°F to 68°F, with the 49°F spawning temperature occurring in April. Releases from above the thermocline under the Proposed Action would have temperatures ranging from 55°F to 68°F and releases from below the thermocline would create equivalent period temperatures of 55°F to 56°F. Under both conditions, the spawning temperature of 49°F would continue to occur in April. Based on the temperature criteria for leatherside chub described above for the discussion of Diamond Fork Creek impacts, neither of the spring and summer temperature regimes originating from above or below the Strawberry Reservoir thermocline would have a significant adverse impact on leatherside chub in the upper Spanish Fork River.

As discussed previously for Diamond Fork Creek, a possibility exists that the greater number of trout occurring as a result of the Proposed Action could increase the percentage of leatherside chub lost to predation. Trout

standing crop is estimated to increase from 8 pounds per acre to 35 pounds per acre. Although 35 pounds per acre is still a relatively low density of trout, it is over 3 times more than the present number of brown trout. This potential for increased predation on leatherside chub is partially mitigated by the fact that the flow conditions that increase habitat for trout (leading to increased trout production) should also improve the habitat for leatherside chub, thereby creating increased numbers of leatherside chub. In a "best case" scenario, the mutual increases in the numbers of these two species would be roughly similar, and the percentage of leatherside chub lost to trout predation would be unchanged from the existing conditions. In a "worst case" scenario, the numbers of leatherside chub in the upper Spanish Fork River would decline to an unknown degree because increased numbers of brown trout could result in significantly increased predation on leatherside chub.

Lower Spanish Fork River. The 4.4 miles of river between the Strawberry Diversion Dam and the Mill Race Canal Diversion presently receive no flow except during the irrigation season, although 3 to 5 cfs of spring seepage sustains fish in the 2.8 miles of creek below the East Bench Diversion. The Proposed Action would provide year-round flows through this reach that would benefit leatherside chub (see Table 3.6-8 in Section 3.6.6.3.2.6). Because the trout population of this reach would also increase, increased predation on leatherside chub is likely to occur. Even with greater predation, the doubling of available year-round habitat should increase the number of leatherside chub in this reach over baseline conditions.

Under baseline conditions, the fisheries in the lowermost river (downstream of the Lake Shore Diversion) are limited by July and August flows of 3 cfs. The Proposed Action would increase the July and August flows to 16 and 10 cfs, respectively (see Table 3.6-8 in Section 3.6.6.3.2.6). Instream flows in excess of these proposed flows are not possible under the present allocation of water to water users. This flow regime would benefit the existing fisheries of the lowermost river primarily by increasing summer flows, although summer temperatures would still be marginal for trout but beneficial for leatherside chub. The increases in flows during winter months would not be so great as to adversely affect the fish population through increased turbidity and a reduction in suitable habitat because of increased current velocities.

3.7.6.3.2.3 Invertebrates

Utah Hydroporus Diving Beetle. A lack of information on the distribution, life history, and habitat requirements for this species makes it difficult to derive an accurate assessment of operational impacts. The species could be extinct as it is only known from the type specimen collected in 1941. If the species still exists, operation of the Proposed Action would not adversely affect potential suitable habitat as a result of delivery of water or changes in springflows.

Utah Valvata Snail. Operation of the Proposed Action would likely have no adverse effect on the Utah valvata snail as the species is believed to be extirpated in Utah. Operation of the Proposed Action would not adversely affect potential suitable habitat as a result of delivery of water or changes in springflows. Potential habitat within southern Utah County would not be affected by the operation of the Proposed Action. Effects on spring-fed complexes would be limited to minor and unquantifiable lateral expansion of wetlands near discharge points. Within eastern Juab County, increased discharges from springs would likely increase the amount of shallowly ponded marsh habitat within the large headwater spring areas associated with upper Currant Creek. This increase in shallowly ponded, spring-fed wetland area would provide increased suitable habitat for the species if it occurs in the impact area of influence. Suitable habitat for the Utah valvata snail does not occur within Mona Reservoir, West Creek, and lower Currant Creek; changes in water level elevations, water quality, or flows would not affect the species.

Utah Physa. Operation of the Proposed Action would affect the Utah physa habitat; however, only a small portion of the species range and population occurs in the impact area of influence.

Thickshell Pondsnail. The thickshell pondsnail is considered extinct by the FWS (1994e), and no live specimens have been observed since the 1930s (Clarke 1991). If the species remains extant, however, operation of the Proposed Action would not adversely affect potential suitable habitat as a result of delivery of water or changes in springflows. Therefore, the potential impact is considered not significant.

California Floater. Operation of the Proposed Action would not affect the suitable habitat potentially supporting the California floater.

3.7.6.3.2.4 Amphibians

Spotted Frog. Increased discharges from springs in southern Utah and eastern Juab Counties would occur under the Proposed Action primarily as the result of higher irrigation return flows resulting from the application of additional Bonneville Unit supplies, as well as assumed improvements in distribution system efficiencies. Increased spring discharges could benefit many wetland-associated species, including the spotted frog, by creating a slight lateral expansion of wetlands or, at a minimum, stabilizing existing habitat. This benefit would be most noticeable under drought conditions when wetlands would otherwise be more severely stressed.

The Diamond Fork riverine environment does not provide suitable habitat for the spotted frog, and therefore, changes in flows would not affect the species. The only effect of the SFN System on Diamond Fork Creek is through changes in releases of Strawberry Reservoir water to the creek. There would be no effect on spring discharges to the creek, and therefore, no effect on any potential habitat.

Average annual salinity in groundwater discharges is not expected to exceed 433 ppm of TDS in Juab County or 764 ppm of TDS in Utah County. There would be no change in the salinity of groundwater discharge in Diamond Fork Creek. These levels are well within the tolerance limits of the species based on recent studies of salinity effects on related species in the family *Ranidae* (Jennings 1994). For example, post-metamorph red-legged frogs (*Rana aurora*) have been found to tolerate salinities from 9,000 to 12,000 ppm of TDS before exhibiting adverse effects. The embryos of red-legged frogs can exhibit adverse effects at lower thresholds of about 4,500 ppm. As a result, operation of the Proposed Action is not expected to significantly impact the spotted frog or its known or potential habitats, and would not conflict with the goals of the Spotted Frog Conservation Agreement (Utah Division of Wildlife Resources 1997d).

Western Boreal Toad. The elevation in groundwater discharges would increase or maintain the amount of habitat available; salinity increases would have no effect. As a result, operation of the Proposed Action would have no significant impacts to the species.

3.7.6.3.2.5 Birds. No significant impacts on bird species of special concern would result from operation of the Proposed Action. Changes in river flows and in farmland irrigation methods could increase the prey base for the raptor species (bald eagle, golden eagle, ferruginous hawk, and burrowing owl). Important winter roost sites and foraging habitat for bald eagle in Diamond Fork Canyon and at Mona Reservoir could be beneficially affected by operations. The increases in winter and spring flows to a minimum of 60 to 80 cfs, combined with a reduction of later summer flows, would increase the overall fish biomass within Diamond Fork Creek. This increase in an important food source of the bald eagle would provide a benefit to the species.

The western least bittern, snowy plover, white-faced ibis, black tern, caspian tern, common yellowthroat, yellow-breasted chat, American white pelican, and long-billed curlew could benefit from increased spring discharges as it would increase marsh habitat in other areas near West Creek and Currant Creek. Abundant foraging habitat exists for the white-faced ibis, although a small amount could be lost from the conversion of flood-irrigated cropland to sprinkler-irrigated cropland.

Bioaccumulation of selenium above threshold levels for reproductive effects in bald eagles feeding on fish from Mona Reservoir is not predicted to occur as a result of the operation of the SFN System. The expected increase in selenium would be small and within the toxicity threshold for fish- and invertebrate-eating birds. Additionally, fish contain lower selenium concentrations in winter (when eagles are present) than in spring. Furthermore, selenium bioaccumulation during the winter would not affect reproduction after the eagles returned to their nesting territories, based upon studies with mallards that were designed to test the effects of over-winter exposure followed by migration to "clean" nesting areas (Heinz 1993; Heinz and Fitzgerald 1993). Impacts resulting from exposure to pesticides would not be expected as organochloride pesticide residues are currently below detection limits and the operation of the SFN System would not be expected to significantly increase pesticide use. Additionally, accumulation of selenium in migrating, wintering, or occasional fish- or invertebrate-eating birds would not be expected to cause a significant effect on reproduction as effects of selenium exposure within the short time period during which egg formation occurs is most important in the potential effects on reproductive success (Heinz 1993; Heinz and Fitzgerald 1993).

3.7.6.3.2.6 Mammals. No significant impacts to special-status mammals are expected to occur from operation of the Proposed Action.

3.7.6.3.2.7 Reptiles. No significant impacts to special-status reptiles are expected to occur from operation of the Proposed Action.

3.7.6.3.3 Mitigation

3.7.6.3.3.1 Plants. The mitigation measure proposed to reduce the impacts of the operation of the SFN System on the Ute ladies'-tresses includes the implementation of a long-term monitoring program within colonies that may be affected by hydrologic changes. The monitoring would be implemented prior to project operation and would commence within the first growing season following the SFN System Record of Decision.

Monitoring would be implemented in all colonies potentially impacted by changes in stream flows along Diamond Fork Creek and the Spanish Fork River. Monitoring for the effects of the Proposed Action would include the following items:

- Use of paired plots (colonies identified with low potential for impact paired with colonies with locations identified with a high potential for impact) to assess the changes in associated vegetation composition over time. This would be correlated with any changes in Ute ladies'-tresses dynamics in order to determine if significant changes in Ute ladies'-tresses numbers or colony viability are associated with natural successional changes from system operation.

- Monitoring groundwater levels bi-weekly through the use of shallow piezometers or monitoring wells throughout the growing season (April through October). Piezometers would be established at regular intervals along transects perpendicular to the river, and intersecting colony locations.

- Comparison of groundwater levels to actual gaged stream flows at the time of monitoring.

- Marking individual plants within permanent plots with metal tags and collecting demographic data for these plots.

- Annual canyon-wide surveys counting all flowering individuals and comparing any changes in colony locations (i.e., measuring recruitment and loss) and numbers of flowering individuals at each location.

- Annual characterization of the vegetation composition and structure in Diamond Fork Canyon.

- Diamond Fork Canyon would be aerial-photographed and mapped on at least 2-foot contours and colony locations would be surveyed to establish a more precise characterization of location and elevation with respect to river channel and water surface elevation. This would include a more accurate survey of channel morphology at colony locations where channel morphology or river course changes as a result of riverine dynamics.

- Soil characterization at selected colony locations would be performed in order to assess soil type and structure that is characteristic of Ute ladies'-tresses habitat.

All data would be collected similarly for both reference and potentially impacted colonies. The monitoring program would be established prior to SFN System/Diamond Fork System operation and would continue for 10 years or longer depending on the results of changes shown by the data collected following initial operation. The monitoring period would be determined jointly by the Mitigation Commission and the FWS at the end of the first 10 years. If the results of the monitoring program indicate greater effects than predicted, flows could be supplemented by releases into the Diamond Fork Creek from the Diamond Fork Pipeline and/or a rescue/transplant program could be initiated.

The concept of adaptive management would be implemented to change the flows over an extended period of time (10 years) rather than immediately upon completion of the "Diamond Fork Tunnel Alternative." This would give newly exposed shoreline areas time to develop into suitable Ute ladies'-tresses habitat. In addition, the species may adjust to this new dynamic and occupy newly "opened" habitat within a 10-year period. Current vegetation analyses and proposed changes in the Diamond Fork drainage do not provide the information to quantify the potential for new habitat development under the Proposed Action flow regime.

3.7.6.3.3.2 Fish. The ultimate effect on leatherside chub of backwater and cutoff pool habitat loss from riparian encroachment, plus increased predation by brown trout, can only be determined through annual monitoring of these habitat types and the leatherside chub population. Should a reduction of leatherside chub be significant, lower Diamond Fork Creek flows and channel configuration could be managed to maintain necessary habitat. In alternate years, water releases could allow peak flows in May to flood backwater and cutoff pool habitats in lower Diamond Fork Creek. Side channels that feed these habitats could be cleared and kept open manually should encroachment of riparian vegetation occur. Prime backwater habitats for leatherside chub could be protected by screened weirs with a mesh size to exclude fish over 6 inches in size.

3.7.6.3.3.3 Birds. In order to reduce the potential for construction impacts on the golden eagle nesting habitat in Diamond Fork Canyon, the CUWCD would ensure that qualified biologists are on site during the construction period to monitor construction activities. The biologist would have the authority to temporarily close the construction site if construction activities were adversely impacting the nesting eagles. In addition, pre-construction surveys for burrowing owls and short-eared owls would be conducted to determine the absence or presence of the species.

3.7.6.3.4 Unavoidable Adverse Impacts. The **potential** impact to Ute ladies'-tresses and its habitat and the potential impact to a nesting golden eagle are considered adverse and unavoidable. All practicable measures would be taken to mitigate for both impacts; however, it is possible that 1) a presently unquantified amount of existing Ute ladies'-tresses habitat would be lost in the Diamond Fork and Spanish Fork drainages and 2) nesting would be interrupted for several years by tunnel and pipeline construction in Red Hollow.

3.7.6.4 MCAPW-DFT Alternative

The MCAPW-DFT Alternative is similar to the Proposed Action in that the "Diamond Fork Tunnel Alternative" (two tunnels, two siphons, and a pipeline) would be constructed to connect the Sixth Water Aqueduct to the Diamond Fork Pipeline. The Main Conveyance Aqueduct would be constructed to deliver water to southern Utah

and eastern Juab Counties. The physical facilities of this alternative would be nearly identical to the Proposed Action; however, the Main Conveyance Aqueduct would not replace the High Line Canal. Instead it would parallel the High Line Canal in the Salem and Payson areas. Operationally, the MCAPW-DFT Alternative would differ from the Proposed Action in that the Main Conveyance Aqueduct would not convey SVP water. The SVP water carried through the "Diamond Fork Tunnel Alternative" and the Diamond Fork Pipeline would be discharged near the mouth of Diamond Fork Creek. Similar to baseline conditions, SVP water would be conveyed by the Spanish Fork River to the Strawberry Diversion Dam. Additionally, distribution pipelines would be constructed as an aspect of the related actions. Impacts to special-status species resulting from construction and operation of the MCAPW-DFT Alternative would be the same as described for the Proposed Action, except as noted below.

3.7.6.4.1 Plants. The impacts to Ute ladies'-tresses and their habitat would be identical to those identified under the Proposed Action for the Diamond Fork drainage because the flow regime for both alternatives are identical. Flows would be increased above baseline and above the Proposed Action flows in Spanish Fork River. While no analysis was performed specifically for these flows, it is anticipated that the impacts would be no greater than that identified for the Proposed Action and that the higher flows may, in fact, reduce the estimated impact of the loss of 1.1 acres of Ute ladies'-tresses habitat expected under the Proposed Action.

3.7.6.4.2 Fish. In the upper Spanish Fork River, flows with an additional 100 to 150 cfs over baseline conditions for most months of the irrigation season make this alternative less beneficial to leatherside chub than the Proposed Action. Increased current velocity and turbidity would be partially offset by the stability of a higher base flow, but there is also a risk of increased predation mortality as brown trout standing crop is estimated to increase from 8 to 28 pounds per acre. The net result for this reach would be a reduction in the number of leatherside chub from the baseline conditions and a significant impact to this population.

Impacts on the Diamond Fork Creek, and Spring Creek populations of leatherside chub resulting from construction of the MCAPW-DFT Alternative would be the same as described for the Proposed Action.

3.7.6.4.3 Mitigation. Mitigation for the MCAPW-DFT Alternative would be the same as described under the Proposed Action.

3.7.6.4.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts would be similar to those described for the Proposed Action.

3.7.6.5 MCAP Alternative

The MCAP Alternative differs primarily from the Proposed Action in that Strawberry Reservoir water would continue to enter the Diamond Fork drainage at the outlet of the Sixth Water Aqueduct and would require the construction of Monks Hollow Dam on Diamond Fork Creek to store and re-regulate this water before it enters the Diamond Fork Pipeline or the downstream creek channel. Under this alternative, the Main Conveyance Aqueduct would be constructed the same as described under the Proposed Action. The following sections describe the potential impacts to threatened, endangered, and species of special concern as a result of construction and operation of the MCAP Alternative, including the distribution, on-farm, and M&I systems.

3.7.6.5.1 Construction Impacts. Construction impacts under the MCAP Alternative would be the same as those described for the Proposed Action except as described below.

3.7.6.5.1.1 Plants. Because Monks Hollow Dam and Reservoir would be constructed under the MCAP Alternative, a colony of Ute ladies'-tresses (Colony 1 on Table 3.7-3) at the dam site would be subject to mechanical disturbance by construction activities. Thus, 0.24 acre of occupied habitat and two individual plants would be disturbed. Similar to the Proposed Action, no construction impacts would occur along the route for the

Main Conveyance Aqueduct as the alignment would remain outside of the Spanish Fork River until it crosses the Spanish Fork River below the Strawberry Diversion Dam.

3.7.6.5.1.2 Birds. Construction of Monks Hollow Dam and Reservoir under the MCAP Alternative could have a direct impact on the known pair of golden eagles that have seven to eight nests within 1.0 mile of the dam site. Construction activities within 1.0 mile of golden eagle nest sites would increase the potential for nest abandonment, loss of eggs and young, and a resulting short-term decline in the recruitment of the local population. Another tree nest used by a pair of golden eagles was recently discovered upstream, but within the reservoir basin; this nest would eventually be lost through reservoir clearing operations. Temporary reductions in the local prey base could also occur during construction. Construction impacts on golden eagle foraging habitat are not considered significant as the duration of the impacts would be short-term and higher value foraging habitat is available throughout the region. The CUWCD would work with the FWS and Utah Division of Wildlife Resources to obtain necessary permits and comply with all conditions of the permits issued.

3.7.6.5.2 Operation Impacts. Impacts to special-status species as a result of operation of the MCAP Alternative would be the same as described for the Proposed Action except as noted below.

3.7.6.5.2.1 Plants.

Diamond Fork Creek. The inundation impacts of Monks Hollow Reservoir would cause the loss of 0.4 acre of occupied habitat. Flows in the Diamond Fork Creek would be similar to the flows analyzed for the Proposed Action except that they would be lower in April and May (60 versus 88 cfs and 81 versus 144 cfs, respectively) nearly identical in June and August, and significantly greater (194 versus 106 cfs) in July. While no analysis was completed for the Ute ladies'-tresses for this alternative, it would appear that the potential for impact on these colonies would be greater than that analyzed for the Proposed Action.

Spanish Fork River. Ute ladies'-tresses habitat would be impacted similarly to that previously described for the Proposed Action.

3.7.6.5.2.2 Fish. Habitat and predation impacts on the Diamond Fork Creek population of leatherside chub resulting from operation of the MCAP Alternative would be the same as described for the Proposed Action. Water temperatures would be colder than that resulting from the Proposed Action and may interfere with leatherside trout reproduction. Strawberry Reservoir releases from above the thermocline are not a problem because the MCAP Alternative temperatures in Diamond Fork Creek would range from a May low of 51°F to a July high of 69°F. However, when Strawberry Reservoir releases occur from below the thermocline, the MCAP Alternative temperature range for May through September would be 45°F in May with the rest of the summer months averaging 46°F to 48°F. Because a temperature of 49°F triggers leatherside chub spawning, the MCAP Alternative could potentially create years in which leatherside chub fail to spawn.

Impacts on the upper and lower Spanish Fork River populations of leatherside chub resulting from construction and operation of the MCAP Alternative would be the same as described for the Proposed Action.

3.7.6.5.3 Mitigation. Mitigation for the MCAP Alternative would be the same as described for the Proposed Action, except as follows.

3.7.6.4.3.1 Plants. Two mitigation measures are proposed to reduce the impacts of the operation of the SFN System on the Ute ladies'-tresses: 1) the transplantation of individuals potentially inundated by Monks Hollow Reservoir and 2) the implementation of a monitoring program within colonies potentially impacted by hydrologic changes. Both measures would be implemented prior to project operation and would commence within the first growing season following the SFN System Record of Decision. The second mitigation measure has been described under the Proposed Action. The transplantation mitigation is described below.

The transplantation measure would require marking all flowering individuals observed within the area to be inundated by Monks Hollow Reservoir (estimated at 194 individuals). These plants would be removed from the inundation area and stored at the Red Butte Arboretum or, to prevent pollination by Ute ladies'-tresses from the Uinta Basin, at another storage site determined jointly by the FWS and CUWCD. Following the commencement of project operation, the stored individuals would be transplanted into suitable habitat exposed as a result of the reduction in stream flows along Diamond Fork Creek. A preliminary habitat suitability assessment would be made based upon visual observations of the site, particularly of the vegetation type. Suitability would be confirmed based upon water level monitoring (using shallow piezometers) and vegetation monitoring.

3.7.6.5.4 Unavoidable Adverse Impacts. The unavoidable adverse impacts of the MCAP Alternative would affect Ute ladies'-tresses and golden eagle nesting sites as described for the Proposed Action; however, additional amounts of habitat would be lost as a result of construction of Monks Hollow Dam. One golden eagle nest would be lost as a result of clearing the reservoir basin, and one small colony of Ute ladies'-tresses would be lost as a result of dam construction activities. Another colony of Ute ladies'-tresses would be inundated when the reservoir is filled since it is within the reservoir basin upstream from the dam.

3.7.6.6 MCAPW Alternative

The MCAPW Alternative is similar to the MCAP Alternative except that the SVP water would be discharged from the terminus of the Diamond Fork Pipeline near the mouth of Diamond Fork Creek. This SVP water would then flow through the 4.2 miles of the upper Spanish Fork River to the Strawberry Diversion. The following sections describe the construction- and operation-related impacts that could result from the MCAPW Alternative.

3.7.6.6.1 Construction Impacts. Impacts on special-status species resulting from construction of the MCAPW Alternative would be the same as those described for the MCAP Alternative.

3.7.6.6.2 Operation Impacts. The flows in Diamond Fork Creek under the MCAPW Alternative would be the same as with the Proposed Action. In the Spanish Fork River, the average maximum August flow would be approximately 9 percent higher than with the MCAP Alternative. An analysis of the stage-discharge relationships indicates that the increased flow in the Spanish Fork River would increase the average maximum water level by less than 3 inches. Consequently, the operational impacts of the MCAPW Alternative on special-status species would not be measurably different from those of the MCAP Alternative except as noted below.

3.7.6.6.2.1 Fish. Impacts on the Diamond Fork Creek and lower Spanish Fork River populations of leatherside chub resulting from construction and operation of the MCAPW Alternative would be the same as described for the MCAP Alternative. In the upper Spanish Fork River, flows with an additional 100 cfs over baseline conditions for most months of the irrigation season make this alternative less beneficial to leatherside chub than the Proposed Action. Increased current velocity and turbidity would be partially offset by the stability of a higher base flow, but there is also a risk of increased predation mortality as brown trout standing crop is estimated to increase from 8 to 28 pounds per acre. The net result for this reach would be a reduction in the number of leatherside chub from the baseline conditions and a significant impact to this population.

3.7.6.6.3 Mitigation. Mitigation would be the same as described for the MCAP Alternative.

3.7.6.6.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts would be the same as described for the MCAP Alternative.

3.7.6.7 MCATC Alternative

The MCATC Alternative is essentially the same as the MCAP Alternative except that the Main Conveyance Aqueduct would cross the Spanish Fork River at a different location and a tunnel through Loafer Mountain would

be constructed. The following sections describe the potential impacts to threatened, endangered, and species of special concern as a result of construction and operation of the MCATC Alternative, including the distribution, on-farm, and M&I systems.

3.7.6.7.1 Construction Impacts. Construction impacts resulting from the MCATC Alternative would be the same as described for the Proposed Action except as noted below.

3.7.6.7.1.1 Plants. The alignment for the MCATC Alternative would remain outside the Spanish Fork River riparian wetlands until it crosses the Spanish Fork River at Pole Canyon. This section of the river has been channelized and contains no Ute ladies'-tresses habitat. No facilities or staging areas that would disrupt the soil through removal or filling would be located in any of the riparian wetlands between the confluence with Diamond Fork Creek and the Strawberry Diversion Dam. There would be no direct impacts to the Ute ladies'-tresses under the MCATC Alternative.

3.7.6.7.1.2 Fish. Impacts on the Diamond Fork Creek and Spanish Fork River populations of leatherside chub resulting from construction and operation of the MCATC Alternative would be the same as described for the MCAP Alternative. No significant impacts to other special-status fish species would occur as a result of construction of the MCATC Alternative.

3.7.6.7.1.3 Amphibians. Impacts to the boreal toad would be the same as described for the Proposed Action; however, loss of upland habitat available to boreal toad would be less under the MCATC Alternative, but would not be a substantial benefit to the species.

3.7.6.7.1.4 Birds. Blasting could cause wintering bald eagles and golden eagles to avoid potential use areas, especially those near the Spanish Fork River. The extent of blasting disturbance would depend on the intensity and duration of blasting, distance and line of site of the blasting location to use areas, and the tolerance level of individual birds. The impact of blasting on bald eagles or golden eagles would be considered not significant.

3.7.6.7.1.5 Mammals. Blasting near Loafer Mountain and other rocky locations could disturb potential bat roosting habitat; however, since the bat species have not been documented within the impact area of influence and suitable cliff habitat is abundant along the Wasatch Front and neighboring mountains, this impact is considered to be not significant.

3.7.6.7.2 Operation Impacts. For all special-status species, operational impacts under the MCATC Alternative are the same as those described for the MCAP Alternative.

3.7.6.7.3 Mitigation. Mitigation measures would be the same as those described for the MCAP Alternative.

3.7.6.7.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts would be the same as described for the MCAP Alternative.

3.7.6.8 MCAT Alternative

The MCAT Alternative is designed nearly the same as the MCATC Alternative, but it would not convey SVP water past the terminus of the Diamond Fork Pipeline. For this reason, upper and lower Spanish Fork River flows for the MCAT Alternative are the same as those described previously for the MCAPW Alternative. The following sections describe the potential impacts to special-status species from construction and operation of the MCAT Alternative, including the distribution, on-farm, and M&I systems.

3.7.6.8.1 Construction Impacts. Construction impacts under the MCAT Alternative would be same as those described for the MCATC Alternative.

3.7.6.8.2 Operation Impacts. Operational impacts under the MCAT Alternative are the same as those described for the MCAP Alternative, with the exception of Ute ladies'-tresses and leatherside chub, as described below.

3.7.6.8.2.1 Ute Ladies'-Tresses. The hydrologic regime for Diamond Fork Creek resulting from the MCAT Alternative would be the same as that resulting from the MCAP Alternative. Therefore, operational impacts would be the same as those identified for the MCAP Alternative.

The MCAT Alternative differs from the Proposed Action in that water for the Strawberry Water Users Association would be conveyed in the upper Spanish Fork River to the Strawberry Diversion Dam, rather than within the SFN System Main Conveyance Aqueduct. Under the MCAT Alternative, flows remain above 500 cfs during May and June, peaking in July at 527 cfs. During the critical flowering period of August, flows average more than 93 cfs higher than under baseline conditions. During the winter months, flows remain at a fairly constant level of 114 cfs. Under this hydrologic regime, the magnitudes of the flood flows would continue to inundate the occupied habitats as they do under baseline conditions. Thus, the changes in hydrologic regime would not result in significant adverse effects to the general maintenance and persistence of colonies along the Spanish Fork River.

Because of the increase in river water surface levels during the August peak flowering period, no colonies would be subject to drought stress during this critical time period, as all would remain within 18 inches of the August water surface. However, duration of inundation would increase by 23 days during the growing season and by more than a week during July at Colonies 1 and 2 (E.O. 14), resulting in anoxic soil conditions and conversion of these occupied habitats to an unsuitable condition. Although the inundation duration of Colonies 2 and 3 (E.O. 15) would not increase by more than 14 days over the entire growing season, it would increase by more than 1 week during July, resulting in potentially anoxic soil conditions. Overall loss is estimated at 1.5 acres of occupied habitat. This represents 44 percent of the occupied habitat along the Spanish Fork River, including one of the habitats identified as prime Ute ladies'-tresses habitat. Increases in growing season inundation are less than 1 week at the other colonies and would not exceed the significance criterion.

3.7.6.8.2.2 Leatherside Chub. Impacts on the Diamond Fork Creek and Spanish Fork River populations of leatherside chub resulting from construction and operation of the MCAT Alternative would be the same as described for the MCAPW Alternative.

3.7.6.8.3 Mitigation. Mitigation would be same as described under the MCAP Alternative.

3.7.6.8.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts would be similar to those described for the MCAP Alternative.

3.7.6.9 No Action Alternative

The SFN System would not be constructed under the No Action Alternative. However, the diversion of water into the existing Diamond Fork Pipeline would require the construction of Three Forks Dam and Reservoir at Three Forks. The existing Diamond Fork Pipeline would be extended upstream 2.5 miles to Three Forks Dam.

3.7.6.9.1 Construction Impacts. Three Forks Dam would be located upstream of all Ute ladies'-tresses colonies. Construction of the Diamond Fork Pipeline extension could affect the pair of golden eagles with seven to eight nests in the vicinity of Monks Hollow and the golden eagle tree nest near the Three Forks Dam site. These impacts would be similar to those described for Monks Hollow Dam under the MCAP Alternative.

3.7.6.9.2 Operation Impacts. Operations under the No Action Alternative would greatly increase flows in the Spanish Fork River, but would not supply irrigation water to eastern Juab or southern Utah Counties above the amount already specified in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). As a result, no

significant impacts would occur to any special-status species with the exception of Ute ladies'-tresses and leatherside chub, as discussed below.

3.7.6.9.2.1 Ute Ladies'-Tresses. In Diamond Fork Creek, the flow regime under the No Action Alternative would be significantly less during June and July than any of the action alternatives and would be 33 percent or less of the average monthly flow for June, July, and August when compared to baseline conditions. While no analysis was completed for the No Action Alternative, it would appear that the **potential** for impacts on the existing Ute ladies'-tresses habitat would be as great or greater than the Proposed Action. However, since most of the Bonneville Unit water would be delivered to Utah Lake and the Main Conveyance Aqueduct would not be built, the flows could be altered between the Diamond Fork Pipeline and the stream channel for maximum flexibility in stream channel flows. This flexibility could 1) be used to maintain the existing habitat as much as possible, 2) be altered to help create more habitat, or 3) be used to conduct research on existing colonies to determine more about the species and its needs.

The flows in the Spanish Fork River would be higher than baseline flows year round. During the growing season, flows would increase 9 percent in June to a maximum increase of 71 percent in September. It is estimated that two colonies (1.5 acres) in the Spanish Fork drainage would have the potential to be impacted as a result of the high flows.

3.7.6.9.2.2 Leatherside Chub. Habitat and predation impacts on the Diamond Fork Creek population of leatherside chub resulting from construction and operation of the No Action Alternative would be the same as those described for the Proposed Action. Water temperatures would be colder than those resulting from the Proposed Action and may interfere with leatherside chub reproduction. Strawberry Reservoir releases from above the thermocline would not adversely affect leatherside chub because the No Action Alternative temperatures for May through September in Diamond Fork Creek would range from a May low of 50°F to a July high of 69°F. However, when Strawberry Reservoir releases were to occur from below the thermocline, the No Action Alternative temperature range for May through September would be 46°F in May with a high of 49°F occurring in August. Because a temperature of 49°F triggers leatherside chub spawning, the No Action Alternative could have years in which leatherside chub spawning is delayed until August, which could jeopardize the survival of that year class of fish.

In the upper Spanish Fork River, the No Action Alternative would increase flows during May through August by only 40 cfs over baseline. However, during most of the remaining year, flows with an additional 150 to 250 cfs over baseline conditions would occur. Since this alternative is estimated to increase trout standing crop from 8 to 9 pounds per acre, brown trout predation should not be a problem. The substantially increased current velocity and turbidity would decrease the amount of suitable habitat for leatherside chub. This habitat loss and the corresponding reduction in the leatherside chub population size in this reach would be a significant impact to leatherside chub. Flows in the lower Spanish Fork River would have the same seasonal flow limitations as baseline conditions and would result in no change to the fisheries.

3.7.6.9.3 Mitigation. Mitigation measures would be the same as those described under the Proposed Action.

3.7.6.9.4 Unavoidable Adverse Impacts. The loss of nesting for several years on one golden eagle nest and potential loss of Ute ladies'-tresses habitat are considered unavoidable adverse impacts of the No Action Alternative.

3.7.6.10 Summary of Impacts

Of the 50 species listed in Table 3.7-1, three species (i.e., Ute ladies'-tresses, leatherside chub, and golden eagle) would be significantly impacted to varying degrees by construction or operation of the Proposed Action and alternatives. These impacts are summarized in Table 3.7-5.

Table 3.7-5
Summary of Impacts to Selected Special-Status Species
Page 1 of 4

Species (Status*)	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Ute ladies'-tresses (T)	Operation could potentially impact 9.3 acres of occupied habitat in Diamond Fork Canyon and 1.1 acres in Spanish Fork Canyon.	Significant	A 10-year monitoring program would be implemented and flows could be altered to reduce the impacts during operation to a level acceptable to FWS.	Significant
Golden eagle (SC)	Potential for nest abandonment, loss of eggs and young, and short-term decline in recruitment of localized population as a result of construction of Red Mountain Tunnel and Red Hollow Pipeline.	Significant	On-site monitoring by qualified biologist and additional mitigation measures to be determined by the FWS and Utah Division of Wildlife Resources.	Significant
Leatherside chub (SC)	Diamond Fork Creek main channel habitat increased 25 percent from decreased high flows.	Significant	None	Significant
	Important cutoff pool and backwater habitats in Diamond Fork Creek decrease with encroaching riparian vegetation and bank stabilization.	Significant	Map and monitor cutoff pools and backwaters occurring under new flow regime. Identify critical habitats and maintain through connections to the main channel flows.	Significant
	Increased predation by brown trout in Diamond Fork Creek and Spanish Fork River.	Significant	None	Significant
MCAPW-DFT Alternative				
Ute ladies'-tresses (T)	Same as Proposed Action.			
Leatherside chub (SC)	Diamond Fork Creek impacts the same as Proposed Action.	Significant	Same as Proposed Action.	Significant
	Upper Spanish Fork River habitat reduction from high flows, plus a risk of increased predation from brown trout.	Significant	None proposed	Significant

Table 3.7-5
Summary of Impacts to Selected Special-Status Species

Page 2 of 4

Species (Status*)	Impact	Significance	Mitigation	Significance After Mitigation
Golden eagle (T)	Same as Proposed Action.			
MCAP and MCATC Alternatives				
Ute ladies'-tresses (T)	Construction and operation of Monks Hollow Dam: Loss of 0.64 acre of occupied habitat.	Significant	Individual plants within the area to be inundated by Monks Hollow Dam would be transplanted into suitable habitat along Diamond Fork Creek. Operational mitigation same as Proposed Action.	Significant
	Spanish Fork River: Potential loss of 1.1 acres of currently occupied habitat.	Significant		Significant
	Diamond Fork Creek: Potential loss of occupied habitat as great or greater than the Proposed Action.	Significant		Significant
Leatherside chub (SC)	Diamond Fork Creek habitat and predation impacts the same as Proposed Action.	Significant	Same as Proposed Action.	NA
	When water releases are from below thermocline, Diamond Fork Creek summer temperatures of 45°F to 48°F could inhibit spawning.	Significant	Monitor to determine the degree of impact, then take measures to increase water temperatures if needed.	NA
Golden eagle (T)	Potential for nest abandonment, loss of eggs and young, and short-term decline in recruitment of localized population as a result of construction of Monks Hollow Dam and Reservoir.	Significant	Same as Proposed Action.	Significant
MCAPW Alternative				
Ute ladies'-tresses (T)	Spanish Fork River: Loss of 171 individuals and 1.5 acres of currently occupied habitat.	Significant	Same as described for the Proposed Action.	Not significant
	Diamond Fork Creek: Loss of 626 individuals and 1.7 acres of occupied habitat (same as Proposed Action).	Significant		Not significant
	Monks Hollow Reservoir: Loss of 194 individuals and 0.4 acre of occupied habitat.	Significant		Not significant

Table 3.7-5
Summary of Impacts to Selected Special-Status Species

Page 3 of 4

Species (Status*)	Impact	Significance	Mitigation	Significance After Mitigation
Leatherside chub (SC)	Diamond Fork Creek habitat and predation impacts the same as Proposed Action.	Significant	Same as Proposed Action.	NA
	Diamond Fork Creek temperature impacts the same as MCAP Alternative.	Significant	Same as MCAP Alternative.	NA
MCAT Alternative				
Ute ladies'-tresses (T)	Same as MCAPW-DFT Alternative and construction and inundation impacts of Monks Hollow Dam under MCAP Alternative.			
Leatherside chub (SC)	Same as MCAPW-DFT Alternative.			
Golden eagle (SC)	Same as Proposed Action.			
No Action Alternative				
Ute ladies'-tresses (T)	Spanish Fork River: Loss of 171 individuals and 1.5 acres of currently occupied habitat.	Significant	Same as described for the Proposed Action.	Not significant
	Diamond Fork Creek: Loss of 626 individuals and 1.7 acres of occupied habitat (same as Proposed Action).	Significant		Not significant
	Monks Hollow Reservoir: Loss of 194 individuals and 0.4 acre of occupied habitat.	Significant		Not significant
Leatherside chub (SC)	Diamond Fork Creek habitat and predation impacts the same as Proposed Action.	Significant	Same as Proposed Action.	NA
	When water releases are from below the thermocline, Diamond Fork Creek would not reach the spawning temperature of 49°F until August. This could impact YOY survival and species recruitment.	Significant	Same as MCAP Alternative.	NA
	Upper Spanish Fork River would exhibit a decrease in leatherside habitat and numbers from high flows.	Significant	None proposed.	NA

Table 3.7-5
Summary of Impacts to Selected Special-Status Species
Page 4 of 4

Species (Status*)	Impact	Significance	Mitigation	Significance After Mitigation
Golden eagle (SC)	Same as MCAPW-DFT Alternative.			

Note: This summary includes both construction- and operation-related impacts.
*Status definitions: T, threatened; SC, species of special concern.

3.7.7 Cumulative Impacts

Chapter 1, Section 1.8 identifies the projects included in the cumulative analysis for the Proposed Action. The following is an analysis of each project with respect to the potential cumulative impacts that may occur with implementation of the Proposed Action and alternatives.

Recreation Trail. The regional recreation trail plans as described in Section 1.8 would not have any cumulative impact on special-status species when combined with the Proposed Action and alternatives.

Nephi Airport. Expansion of the Nephi Airport is proposed within existing agricultural lands near the existing airport property. It is not anticipated that the airport expansion would have a cumulative impact on special-status species when combined with the Proposed Action and alternatives.

Utah Lake Preserve. Implementation of the Utah Lake Preserve as proposed, combined with the Proposed Action and alternatives would not result in any cumulative adverse impacts to special-status species. It is possible that implementation of the Utah Lake Preserve could result in a beneficial impact resulting from the net increase in the amount of wetland habitat within the region. This increased habitat could be beneficial to special-status species such as the Utah valvata snail, and cumulatively, the additional water provided by the SFN System could assist in future enhancement endeavors.

Western Transportation Corridor Expansion (Legacy Project). The Legacy Project would be constructed from Nephi to Ogden, passing west of Mona Reservoir and Utah Lake. Although details for the alignment are not available at this time, it is likely that the roadway would cross wetland and terrestrial habitat preferred by special-status species. However, without further information, it is not possible to quantify whether an adverse cumulative impact would occur.

Diamond Fork Creek and Sixth Water Creek Restoration Plan. The Diamond Fork Creek and Sixth Water Creek Restoration Plan would be designed to enhance cottonwood growth, riparian habitat establishment, and re-establish the stream corridor of both creeks, resulting in a beneficial impact to special-status species such as the bald eagle (increased foraging habitat) and leatherside chub. Water supplies in Sixth Water and Diamond Fork Creeks could be used to assist future restoration plans under CUPCA by the Mitigation Commission.

Central Valley Water Reuse Project. The Central Valley Water Reuse Project would provide for conservation, treatment, and reuse of wastewater effluent for irrigation uses within Salt Lake County. It is not possible at this time to determine if there could be any adverse cumulative impacts on special-status species as a result of decreased water quality resulting from the combination of the projects.

3.8 Soils

3.8.1 Introduction

This section addresses potential impacts to soil resources that would result from the construction and operation of the Proposed Action and alternatives and the related distribution and on-farm systems. Potential impacts to surface water quality resulting from erosion and sedimentation are addressed in Section 3.3, Water Quality, and Section 3.6, Aquatic Resources.

3.8.2 Issues Eliminated from Further Analysis

No issues were eliminated from further analysis.

3.8.3 Issues Addressed in the Impact Analysis

No issues or concerns specific to soil resources were identified during the public and agency scoping process. However, the following issues related to soil resources are addressed in this section.

- **Increased Soil Erosion Rates.** Erosion could result from strong wind and/or rain events that occur during construction or before reclamation measures have taken effect if the soils have one or more of the following characteristics: fine to silty texture, low revegetation potentials, or located on slopes greater than 15 percent. Erosion could increase sedimentation and deposition of silt into adjacent areas and waterways.

- **Mixing of Soil Horizons.** Revegetation success would be reduced if topsoils were to mix with coarser, less nutrient-rich subsoils. This impact could reduce land productivity because soil fertility and organic matter decrease.

- **Soil Compaction.** Soil compaction could occur in areas of construction equipment travel, such as staging areas, pipeline rights-of-way, turnouts, and regulating ponds. Compaction of soil could degrade soil structure and reduce revegetation success.

- **Soil Contamination.** Petroleum products that would be used for construction equipment, as well as lubricants and oils that would be used during operation and maintenance, would degrade soils in the event of spills.

- **Trenching and Blasting.** Construction could require trenching and blasting activities that could deposit stones, rocks, and cemented hardpan materials on soil surfaces and reduce the productivity of cultivated and uncultivated vegetation.

3.8.4 Description of Impact Area of Influence

The general impact area of influence for soil resources is the area in southern Utah and eastern Juab Counties that could experience ground disturbance during construction or operation of the SFN System, irrigation distribution systems, and on-farm systems.

3.8.5 Affected Environment

Soils that would be affected by SFN System alternatives are located on a wide range of geographic features, including gently sloping alluvial fans and terraces in the Juab and Goshen Valleys, slopes along the bases of

Loafer Mountain and Mount Nebo, narrow canyons in the Uinta National Forest, and low-lying floodplains in the Mona and Nephi areas. Soils located within the impact area of influence vary widely in characteristics and use.

For this analysis, soil and topographic characteristics that create a potential for erosion or detract from the potential to restore disturbed land have been formed into eight groups to assess the soils affected by the implementation of the Proposed Action and alternatives. A soil can be included in more than one group if it has the characteristics of more than one group. These groups are listed below.

Group 1: Shallow soils (less than 20 inches of soil above bedrock)

Group 2: Hydric soils, as classified by the Natural Resources Conservation Service

Group 3: Soils with high water table (seasonally within 6 feet of the soil surface)

Group 4: Coarse soils (particle size greater than or equal to 2 millimeters in diameter; 15 to 35 percent by volume rock fragments)

Group 5: Erodible soils (slopes greater than 15 percent, moderate to high rain erosion hazard, wind indices of 65 to 310 tons/acre/year)

Group 6: Alkaline or saline soils (electrical conductivity of a saturated extract is greater than 4 µmhos/cm)

Group 7: Clay soils with high shrinkage or expansion potential (greater than 35 percent clay by weight)

Group 8: Dry soils (average annual precipitation less than 9 inches)

Soils of particular concern are those that have high erosion potentials and that make erosion control difficult. These soils may have any one of the following characteristics: they are located on steep slopes and have sandy to silty texture, little existing vegetation, high shrink/swell potential, exposed bedrock, or shallow surface layers. Shallow, coarsely fragmented soils located on steep slopes make reclamation and erosion control measures difficult, especially where the average annual precipitation is less than 9 inches. Areas that would not be as difficult to revegetate are associated with the low-lying floodplains. However, in some of these areas where salinity/alkalinity levels are high, revegetation can be difficult to achieve, which can lead to excessive wind and rain erosion.

The following sections identify sensitive soils that would be affected by construction and operation activities and related actions associated with the Proposed Action and its alternatives.

3.8.5.1 Proposed Action

Soils that would be affected by the Proposed Action have been grouped into three components. These are soils that would be affected by 1) the "Diamond Fork Tunnel Alternative" in the Diamond Fork drainage, 2) the Main Conveyance Aqueduct beginning in Spanish Fork Canyon and ending south of Nephi, and 3) related actions (local development) that would occur in southern Utah and eastern Juab Counties.

3.8.5.1.1 "Diamond Fork Tunnel Alternative." Proposed facilities in the Diamond Fork drainage would be constructed in mountainous terrain, in which the erosion potential concerns include sloping sidehill areas and creek bottoms. The types of soil in the Proposed Action affected environment are identified in Table 3.8-1. The acreages listed are the permanent and temporary rights-of-way for the entire feature and do not indicate acreages in individual soil groups.

Table 3.8-1
Acres and Location of Sensitive Soils Affected by the Proposed Action and MCAPW-DFT Alternative

Facility	Acres	Group 1 Shallow Soils	Group 2 Hydric Soils	Group 3 High Water Table	Group 4 Coarse Soils	Group 5 Erodible Soils	Group 6 Alkaline/ Saline Soils	Group 7 Clay Soils	Group 8 Dry Soils
"Diamond Fork Tunnel Alternative"									
Tanner Ridge Tunnel inlet	4.5	X			X	X			
Tanner Ridge Tunnel outlet, Diamond Fork Siphon, and Red Mountain Tunnel inlet	60.5	X			X	X			
Red Mountain Tunnel outlet and Red Mountain Pipeline	63.0	X			X	X			
Subtotal	**128.0**								
Main Conveyance Aqueduct and Associated Facilities									
Spanish Fork Pipeline	42.2	X			X	X		X	
Snell Canyon Pipeline	63.2	X			X	X			
Salem Bench Pipeline[a]	140.5	X			X	X			
Payson Pipeline	110.6	X			X	X			
Santaquin Pipeline	149.7	X			X	X			
Mona Pipeline	193.4	X			X	X			X
Juab Pipeline	106.1				X				X
Nephi Pipeline	142.7		X		X				X
Recreation Trail	14.8	X			X	X			X
Regulating Ponds	9.8	X			X	X			X
West Mona Pumping Plant	34.3		X	X	X		X	X	X
Main Conveyance Reservoir	38.4	X			X	X			
Access Roads	4.6	X			X	X			X
Construction Staging Areas	48.0	X			X	X			X
Diamond Fork Turnout[b]	4.0		X	X					
Equalization Reservoirs	6.0	X			X	X			X
Subtotal	**1,074.0**								
Total	**1,202.0**								

[a]Area under the MCAPW-DFT Alternative would be approximately 2 acres less than listed.
[b]Applies to the MCAPW-DFT Alternative only.

The mountainous slopes of the Diamond Fork drainage vary from densely vegetated slopes containing grasses, shrubs, and scrub oak to more irregular slopes containing scattered pines, junipers, and rock outcroppings ranging from exposed ledges to massive cliffs. Soils within this area are subject to erosion from exposed slopes and dry

washes when heavy rains or rapid snowmelt occur, which is typical of mountainous areas in the western United States. Tanner Ridge Tunnel, Diamond Fork Siphon, and Red Mountain Tunnel would be constructed on predominantly steep terrain with sloping surfaces and shallow soils. Red Hollow Pipeline would be constructed partially on similar soils, as well as on relatively even terrain in some areas.

Creek bottoms within the Diamond Fork drainage are typically bordered by steep slopes covered with forest soils interspersed with outcroppings of rock and, in several places, unconsolidated fine soils subject to gradual creep toward the creek bottom. Except where roads have been constructed, creek bottoms are generally dominated by shallow forest soils forming the stream banks and riparian zone, with sloped forest floor beyond. The riparian zone supports willows, shrubs, stands of boxelder, and isolated cottonwoods.

The Sixth Water Creek bottom is relatively wide at the proposed location of the Sixth Water Siphon. During construction of the existing Sixth Water Aqueduct, the construction contractor established staging and spoil disposal areas in the creek bottom. Upstream from the Sixth Water Siphon, Sixth Water Creek is bordered by areas of steep slopes of colluvial material, including active earthflows, which are highly erodible. These earthflows (or landslides) continually provide material for erosion. The Mitigation Commission has proposed investigating the feasibility of their stabilization in connection with the stream habitat improvement program proposed in conjunction with the release of minimum flows through Strawberry Tunnel.

Diamond Fork Canyon upstream from Three Forks contains a paved road, which occupies nearly half of the width of the canyon floor along most of the distance to the Diamond Fork Siphon. The road is partially cut into the sloping terrain on the west side of the creek. In many places, the surfaces of the excavated slopes are still bare earth, subject to erosion during heavy rains and spring snowmelt.

From Three Forks downstream to Monks Hollow, the Diamond Fork Canyon floor widens and, in the first mile upstream of Monks Hollow, contains a sandy, sparsely vegetated area that is used for recreation and cattle roundups. Affected sensitive soils for the "Diamond Fork Tunnel Alternative" are identified in Table 3-8.1 The acreages for each feature listed represent the maximum area of disturbance that would be associated with that feature.

3.8.5.1.2 Main Conveyance Aqueduct and Associated Facilities. Spanish Fork Canyon contains steep slopes adjacent to a relatively narrow canyon bottom containing the Spanish Fork River. The slopes contain shallow soils and rock outcroppings. Soils in the canyon bottom are deeper with a high water table. Most of the canyon is unsuitable for agriculture but provides good wildlife habitat. The average annual precipitation for this area is 16 to 22 inches (USDA 1984).

The soils in southeastern Utah Valley that would be affected by construction of the Main Conveyance Aqueduct and associated facilities are generally fine-grained soils deposited on lakebed terraces of ancient Lake Bonneville. They vary from silty clay loam to sandy loam with areas of gravelly, loamy coarse sand. These soils are generally well-drained and well-suited for crop production.

The soils in the Juab Valley and Goshen Valley areas are generally deep and well-drained and are formed from alluvium and sediments. The Juab Valley soils are well-suited for range seeding and, in some areas, sustain crops of alfalfa hay and dry-farmed grains. The average annual precipitation fluctuates between 12 to 16 inches. These soils are suited to agricultural use; however, agricultural production in this area is currently limited by available water supplies (USDA 1984). Areas along the foot of the mountains to the east contain shallow soils that are excessively drained.

In the Mona floodplain, soils are deep and somewhat poorly drained. They were derived from sediments that accumulated and settled out of Lake Bonneville in prehistoric times. Some areas have high salinity/alkalinity and receive an average of 8 to 12 inches of precipitation annually. The area is also associated with a fluctuating water

table that ranges from the surface to a depth of 24 inches (USDA 1984). Areas with a lower water table are used mainly for pasture and irrigated cropland.

Sensitive soils by soil group that may be affected by the Main Conveyance Aqueduct and associated facilities are identified in Table 3.8-1. The acres for each feature shown in the table represent the maximum area of disturbance associated with that facility.

3.8.5.1.3 Related Actions (Local Development). As identified in Chapter 1, Section 1.9, local development in the form of improvements to existing distribution and on-farm systems and the construction of new systems would likely occur as a result of the SFN System. Sensitive soils that would be affected by the construction and operation of these facilities are identified in Table 3.8-2.

3.8.5.1.3.1 Salt Creek Facilities. Salt Creek facilities would be constructed in and adjacent to Nephi to combine water from Salt Creek and certain irrigation wells with Bonneville Unit water to improve the efficiency of local water distribution. The facilities would include a diversion dam, pipeline, and pumping plant.

3.8.5.1.3.2 Distribution Systems. Most of the distribution system improvements would be located in agricultural areas, although some would be along the edge of the Salem Bench. For existing systems to be converted to pipelines, the construction disturbance would generally be along existing irrigation ditches. Most new distribution pipelines would be installed within or adjacent to agricultural land.

3.8.5.1.3.3 On-Farm Systems. While the locations and actual amounts of irrigation system modification are unknown, the types of on-farm system modifications are known to include the development of new irrigation ditches, land leveling, and changes in irrigation practices.

3.8.5.2 MCAPW-DFT Alternative

Sensitive soil types that would be affected by the construction and operation of the MCAPW-DFT Alternative would be the same as those described for the Proposed Action, listed in Table 3.8-1. The acreage shown in the table is an approximation for the MCAPW-DFT Alternative. (The acreage affected by the Salem Bench Pipeline of the Main Conveyance Aqueduct would be two acres less than shown for the Proposed Action, and four additional acres would be affected by the construction of the turnout at the end of the Diamond Fork Pipeline.) The sensitive soils potentially affected by the distribution system improvements under the MCAPW-DFT Alternative would be less extensive than those described for the Proposed Action and are listed on Table 3.8-3.

3.8.5.3 MCAP Alternative

The MCAP Alternative would require the construction of Monks Hollow Dam and Reservoir as described in Chapter 1, Section 1.6.4.2, rather than the "Diamond Fork Tunnel Alternative."

3.8.5.3.1 Monks Hollow Dam and Reservoir. The special categories of soil that would be affected by the construction of Monks Hollow Dam and Reservoir would consist of shallow soils on irregular terrain, rocky slopes with coarse soils, and soils that are erodible because of sloping surfaces on which they would be located. The acreages involved and listed in Table 3.8-4.

3.8.5.3.2 Main Conveyance Aqueduct and Associated Features. Affected soil areas for the MCAP Alternative would be the same as those described for the Proposed Action.

3.8.5.3.3 Related Actions (Local Development). Sensitive soils that would be affected by related actions under the MCAP Alternative would be the same as those described for the Proposed Action and are shown in Table 3.8-2.

Table 3.8-2
Acres and Location of Sensitive Soils Affected by Related Actions (Local Development) Associated with the Proposed Action and MCAP Alternative

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soils	Group 5 Erodible Soils	Group 6 Alkaline/ Saline Soils	Group 7 Clay Soils	Group 8 Dry Soils
Distribution Pipelines									
Salem	98.2	X			X	X			
Mapleton	82.4	X			X	X			
South Field	30.1			X	X	X			
Lateral 20	120.7				X	X			X
SU7	4.8	X				X			
West Mona	68.4			X	X	X	X	X	X
Currant Creek	30.5	X			X				
East Juab Water Efficiency Project	138.6			X					X
North Nephi Distribution System	60.0			X					X
South Nephi Distribution System	132.8			X					X
Subtotal	**766.5**								
Salt Creek Facilities									
Salt Creek Diversion Dam	1.0	X			X	X			
Salt Creek Pipeline*	22.0	X			X	X			
Nephi Wells	1.5						X	X	
Nephi Pumping Plant	0.5				X				
Subtotal	**25.0**								
Total	**791.5**								

*Temporary access roads and construction yards were not included because their locations are not known at this time. The locations of these facilities would be determined by the construction contractor.

Table 3.8-3
Acres of Sensitive Soils Affected by Related Actions (Local Development) Associated with the MCAPW-DFT and MCAPW Alternatives

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soil	Group 7 Clay Soil	Group 8 Dry Soil
Distribution Pipelines[a]									
SU1	2.4					X			
SU2	3.9					X			
SU3	[b]			X	X	X			
SU4	[b]				X	X			X
SU6	[b]			X	X	X			X
SU7	[b]				X				
West Mona	68.4	X					X	X	
Currant Creek	30.5	X			X				
East Juab Water Efficiency Project	138.6			X					X
North Nephi Distribution System	60.0			X					X
South Nephi Distribution System	132.8			X					X
Subtotal	**436.6**								
Salt Creek Facilities									
Salt Creek Diversion Dam	1.0	X			X	X			
Salt Creek Pipeline	22.0	X			X	X			
Nephi Wells	1.5						X	X	
Nephi Pumping Plant	0.5				X				
Subtotal	**25.0**								
Total	**461.6**								

[a]Temporary access roads and construction yards were not included because their locations are not known at this time. The locations of these facilities would be determined by the construction contractor.
[b]These short pipelines would lie on the Main Conveyance Aqueduct right-of-way.

Table 3.8-4
Acres and Location of Sensitive Soils Affected by the MCAP and MCAPW Alternatives

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soil	Group 7 Clay Soil	Group 8 Dry Soil
Monks Hollow Dam and Reservoir									
Monks Hollow Dam	15	X			X	X			
Monks Hollow Reservoir	410	X			X	X			
Monks Hollow Access Road	30	X			X	X			
Subtotal	**455**								
Main Conveyance Aqueduct and Associated Features									
Spanish Fork Pipeline	42.2	X			X	X		X	
Snell Canyon Pipeline	63.2	X			X	X			
Salem Bench Pipeline[a]	140.5	X			X	X			
Payson Pipeline	110.6	X			X	X			
Santaquin Pipeline	149.7	X			X	X			
Mona Pipeline	193.4				X	X			X
Juab Pipeline	106.1				X				X
Nephi Pipeline	142.7		X		X				X
Recreation Trail	14.8	X			X	X			X
Regulating Ponds	9.8	X			X	X			X
West Mona Pumping Plant	34.3		X	X	X		X	X	X
Main Conveyance Reservoir	38.4	X			X	X			
Access Roads	4.6	X			X	X			X
Construction Staging Areas	48.0	X			X	X			X
Equalization Reservoirs	6.0	X							
Diamond Fork Turnout[b]	4.0				X	X			X
Subtotal	**1,074.0**								
Total	**1,529.0**								

[a]Area under the MCAPW Alternative is approximately 2 acres less than listed.
[b]Applies only to the MCAPW Alternative.

3.8.5.4 MCAPW Alternative

Sensitive soil types and areas affected by the construction and operation of the MCAPW Alternative would be the same as those described for the MCAP Alternative. The acreage on the table is an approximation for the MCAPW Alternative. (The acreage affected by the Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct would be slightly less than shown for the MCAP Alternative, and a few additional acres would be affected by the

construction of the turnout at the end of the Diamond Fork Pipeline.) The acreages and sensitive soil types affected by the MCAPW Alternative are shown in Table 3.8-4. Sensitive soil types and the acreages that would be affected by the construction and operation of the MCAPW Alternative would be similar to those described for the MCAP Alternative, as discussed in the following sections.

3.8.5.4.1 Monks Hollow Dam and Reservoir. The affected soil areas would be the same as those described for the MCAP Alternative.

3.8.5.4.2 Main Conveyance Aqueduct and Associated Features. The affected soil areas for the MCAPW Alternative would be the same as those described for the Proposed Action, except that the Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct would parallel the High Line Canal, partially on agricultural land.

3.8.5.4.3 Turnout at End of Diamond Fork Pipeline. The turnout structure at the end of the Diamond Fork Pipeline and the discharge pipe to the Diamond Fork Creek would be constructed on soils having a high groundwater table.

3.8.5.4.4 Related Actions (Local Development). The sensitive soils affected by the related actions under the MCAPW Alternative would be the same as those described for the MCAPW-DFT Alternative. The acreages and sensitive soil types would be as shown in Table 3.8-3.

3.8.5.5 MCATC Alternative

Sensitive soil types that would be affected by the construction and operation of the MCATC Alternative are shown in Table 3.8-5.

3.8.5.5.1 Monks Hollow Dam and Reservoir. The sensitive soils affected by Monks Hollow Dam and Reservoir would be the same as for the MCAP Alternative.

3.8.5.5.2 Main Conveyance Aqueduct and Associated Features. Sensitive soils that would be affected by the Main Conveyance Aqueduct alignment under the MCATC Alternative are identified in Table 3.8-5.

3.8.5.5.3 Related Actions (Local Development). Sensitive soils that would be affected by local development with the MCATC Alternative are identified in Table 3.8-6. The acreages represent the total area affected.

3.8.5.6 MCAT Alternative

3.8.5.6.1 Monks Hollow Dam and Reservoir. The sensitive soils affected by Monks Hollow Dam and Reservoir would be the same as for the MCAP Alternative, shown on Table 3.8-5.

3.8.5.6.2 Main Conveyance Aqueduct and Associated Features. The sensitive soils that would be affected by the MCAT Alternative are the same as those described for the MCATC Alternative.

3.8.5.6.3 Related Actions (Local Development). Sensitive soils that would be affected by related actions anticipated with the MCAT Alternative are identified in Table 3.8-7.

Table 3.8-5
Acres and Location of Sensitive Soils Affected by the MCATC and MCAT Alternatives

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soil	Group 7 Clay Soil	Group 8 Dry Soil
Monks Hollow Dam and Reservoir									
Monks Hollow Dam	15	X			X	X			
Monks Hollow Reservoir	410	X			X	X			
Monks Hollow Access Road	30	X			X	X			
Subtotal	**455**								
Main Conveyance Aqueduct and Associated Facilities									
Spanish Fork Pipeline	32.5	X			X	X		X	
Loafer Mountain Tunnel[a]	0.4	X			X	X			
Salem Bench Pipeline	103.5	X			X	X			
Tithing Mountain Tunnel[a]	0.4	X			X	X			
Peteetneet Pipeline	3.2	X			X	X			
Dry Mountain Tunnel[a]	0.4	X			X	X			X
Santaquin Pipeline	184.1	X			X	X			X
Mona Pipeline	193.4		X		X				X
Juab Pipeline	106.1	X			X				
Nephi Pipeline	142.7		X		X				
Regulating Ponds	9.8	X			X	X			
Equalization Reservoirs	6.0	X			X	X			
West Mona Pumping Plant	34.3		X	X	X		X	X	X
Main Conveyance Reservoir	38.4	X			X	X			
Access Roads	4.6	X			X	X			X
Diamond Fork Turnout[b]	4.0		X	X					
Construction Staging Areas[c]	69.0	X			X	X			X
Subtotal	**932.8**								
Total	**1,387.8**								

[a]Soil disturbance associated with the tunnels (1.2 acres) is limited to the ingress and egress points of access.
[b]Applies only to the MCAT Alternative.
[c]Includes 15 acres for spoil disposal

Table 3.8-6
Acres of Sensitive Soils Affected by Related Actions (Local Development) Associated with the MCATC Alternative

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soil	Group 7 Clay Soil	Group 8 Dry Soil
Distribution Pipelines*									
Salem	77.3	X			X	X			
Mapleton	116.3	X			X	X			
South Field	30.1	X			X	X			
Lateral 20	155.6	X			X	X			
SU2	26.2				X	X			
SU3	24.2			X	X	X			
SU4	20.6				X	X			X
SU6	4.4			X	X	X			X
SU7	4.8				X				
West Mona	68.4	X					X	X	
Currant Creek	30.5	X			X				
East Juab Water Efficiency Project	138.6			X					X
North Nephi Distribution System	60.0			X					X
South Nephi Distribution System	132.8			X					X
Subtotal	**889.8**								
Salt Creek Facilities									
Salt Creek Diversion Dam	1.0	X			X	X			
Salt Creek Pipeline	22.0	X			X	X			
Nephi Wells	1.5						X	X	
Nephi Pumping Plant	0.5				X				
Subtotal	**25.0**								
Total	**914.8**								

***Temporary access roads and construction yards were not included because their locations are not known at this time. The locations of these facilities would be determined by the construction contractor.**

Table 3.8-7
Acres of Sensitive Soils Affected by Related Actions (Local Development) Associated with the MCAT Alternative

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soils	Group 7 Clay Soil	Group 8 Dry Soil
Distribution Pipelines*									
SU2	8.7	X			X	X			
SU3	8.7			X	X	X			
SU4	8.5				X	X			X
SU5	7.3			X	X	X			X
SU6	4.4			X	X	X			
SU7	4.8				X				X
West Mona	68.4				X		X	X	
Currant Creek	30.5	X			X				
East Juab Water Efficiency Project	138.0			X					X
North Nephi Distribution System	60.0			X					X
South Nephi Distribution System	132.8			X					X
Subtotal	**472.9**								
Salt Creek Facilities									
Salt Creek Diversion Dam	1.0	X			X	X			
Salt Creek Pipeline	22.0	X			X	X			
Nephi Wells	1.5						X	X	
Nephi Pumping Plant	0.5				X				
Subtotal	**25.0**								
Total	**497.7**								

*Temporary access roads and construction yards were not included because their locations are not known at this time. The locations of these facilities would be determined by the construction contractor.

3.8.5.7 No Action Alternative

Under the No Action Alternative, the Diamond Fork System would be completed with the construction of Three Forks Dam and Reservoir, the extension of the Diamond Fork Pipeline upstream to Three Forks Dam, and the addition of a turnout at the downstream end of the Diamond Fork Pipeline. Soil types that would be affected are shown in Table 3.8-8.

Table 3.8-8
Acres and Location of Sensitive Soils Affected by the No Action Alternative

Facility	Acres	Group 1 Shallow Soil	Group 2 Hydric Soil	Group 3 High Water Table	Group 4 Coarse Soil	Group 5 Erodible Soil	Group 6 Alkaline/ Saline Soil	Group 7 Clay Soil	Group 8 Dry Soil
Three Forks Dam and Reservoir	22	X		X	X	X			
Diamond Fork Pipeline Extension	45	X			X	X			
Diamond Fork Pipeline Turnout	4		X	X					
Total	71								

3.8.6 Impact Analysis

3.8.6.1 Potential Impacts Considered

This section discusses the potential impacts of construction disturbance anticipated with the "Diamond Fork Tunnel Alternative" and the SFN System Main Conveyance Aqueduct and associated facilities on the eight soil groups identified in Section 3.8.1.

3.8.6.1.1 Construction Activities . Construction activities could affect certain soil characteristics as well as the ability of the soil to support a successful revegetation effort. For example, trenching and grading activities on soils from Groups 1 and 5 (shallow soils with a high erosion hazard) would have the potential to increase erosion rates and reduce soil productivity to a point where successful revegetation would be unlikely. Any activity performed on these soils, especially where soil is being moved by heavy machinery on steep slopes, would have the potential to reduce the already shallow soil layer and to create disturbance that could increase erosion rates where erosion currently occurs. In areas adjacent to waterways, increased soil erosion would lead to increased turbidity and sedimentation and decreased water quality.

If trenching and grading activities were to occur during periods of saturation on soils of Group 3 (soils having a high water table), soil compaction could occur, which, in turn, would reduce soil productivity. This would occur because soils compact more quickly and incur permanent structural damage when they are compacted. If soils having many coarse fragments are disturbed and care is not taken to minimize mixing of soil horizons, the dispersal of coarse fragments throughout the soil could lead to reductions in soil productivity and could prevent successful revegetation efforts.

Soil disturbance at stream crossings would be vulnerable to erosion because of the disturbance of the natural configuration of the banks and bed of the streams. Without restoration, higher flows could erode soil materials and carry them downstream. Soil erosion from construction activities would have the potential to impact water quality and aquatic habitat, as addressed in Section 3.3, Water Quality, and Section 3.6, Aquatics, respectively.

Impacts to soil resources could also result from simple disturbance, without mixing, of soils that are difficult to revegetate. For example, if a large area of alkaline/saline soil that receives less than 9 inches of precipitation a year (Groups 6 and 8) were to be disturbed, revegetation may not be successful within a 3-year period because of climatic conditions and physical constraints of the soil resource. Successful revegetation in areas with alkaline soils that receive low rainfall is more difficult than in areas with deep soils and normal precipitation.

3.8.6.1.2 Operation Activities. Impacts to soil resources from the operation of the "Diamond Fork Tunnel Alternative" and the SFN System would be related to changes in the flow regimes of creeks and changes in groundwater levels. Increased stream bank erosion would cause soil destabilization, soil loss, and a corresponding loss in stream bank vegetation. Soil erosion from operation could also impact water quality and aquatic habitat.

3.8.6.2 Potential Impacts Eliminated from Further Analysis

Improvements to on-farm irrigation systems and water-well drilling would not result in a measurable impact to soil resources; therefore, potential impacts associated with on-farm and M&I systems were eliminated from further analysis. No measurable impacts are anticipated because land eligible to receive Bonneville Unit water has been certified to be suitable for irrigated agriculture and has already been cultivated. Modern well- drilling practices include provisions for containment of drilling fluids and control of disturbed soils at the drilling site.

3.8.6.3 Significance Criteria

Impacts to soil resources are considered significant if construction, operation, or maintenance activities would result in any of the following conditions:

- Increased erosion rates or reduced soil productivity by compaction or soil mixing to a degree that would prevent successful revegetation
- Disturbance of soils with physical and chemical limitations that would prevent successful revegetation
- Reduced agricultural productivity of the soil for more than 3 years because of soil mixing, structural damage, or compaction
- Inhibited revegetation success that could result from contamination by toxic materials, such as fuels, oil, and grease

3.8.6.4 Proposed Action

The following sections describe construction- and operation-related impacts that could result from the Proposed Action. These impacts are summarized in Section 3.8.6.11.

3.8.6.4.1 Construction Impacts. The construction of the "Diamond Fork Tunnel Alternative" and its related access roads would involve soil disturbance in four areas of the Diamond Fork Creek drainage. Construction of the Tanner Ridge Tunnel inlet would involve excavation or mechanical disturbance on the floodplain and lower slope of Sixth Water Canyon. Construction of the Tanner Ridge Tunnel outlet (from which the tunnel would be drilled), Diamond Fork Siphon, Red Mountain Tunnel inlet, and access roads to the tunnels would disturb approximately 128 acres of soil, including areas used for disposal of spoil and access road construction. Because of the steepness of the terrain in most of these areas, disturbance through construction would carry a high risk of erosion, and there would be a potential for disturbed soil material to wash into upper Diamond Fork Creek. Constructing Diamond Fork Siphon would also involve a creek crossing, with its erosion potential.

Upper Diamond Fork Canyon between Three Forks and the proposed location of the Diamond Fork System has a narrow bottom occupied by the creek and a paved USFS road, with slopes rising steeply on each side. Earth and rock occasionally slide or are washed onto the road through natural erosion. The maintenance of this paved road would involve removal of this earth and stone. This work would create a potential source of soil erosion into the creek.

The Red Mountain Tunnel outlet (from which the tunnel would be drilled) and Red Hollow Pipeline would affect soils in Red Hollow and adjacent bench land to the west. Steep slopes would be encountered at the tunnel outlet and at places along the pipeline; however, most of the pipeline would be constructed on terrain having flatter slopes, but still vulnerable to erosion during storms or when snowmelt occurs. The last few hundred feet of Red Hollow Pipeline would descend a steep slope into Diamond Fork Canyon.

No significant impacts to the sensitive soils identified in Table 3.8-1 would be likely to occur as a result of construction activities because construction would be accompanied by the implementation of the standard operating procedures identified in Appendix B, *Standard Operating Procedures*, and best management practices identified in Appendix A, *Erosion Control, Revegetation, and Maintenance Plan.* The specific measures identified in Appendix A were developed based on the soil constraints identified in this analysis. Specific practices that would secure some potential problem areas include the installation of temporary or permanent slope breakers and sediment barriers and the application of mulch material prior to revegetation. Permanent erosion control devices, such as netting, would also be installed to control gully erosion and slope failure. However, it is likely that the construction would increase the erosion of soil into creeks in spite of precautions because of the steepness of some of the terrain on which construction would occur. The likelihood of discharge of toxic materials onto soil resources would be low as a result of restrictions and procedures that the construction contractor would be required to follow.

In southern Utah and northern Juab Counties, construction disturbance on areas that currently support low plant densities, particularly in the sagebrush and juniper community types, could be difficult to successfully revegetate and could require more than 3 years to return to baseline conditions. To encourage successful revegetation, natural seed mixtures and mulching with no or low amounts of fertilizer would be used. By keeping the available nutrients similar to the surrounding soil types, native plants would have better success at revegetation.

Direct impacts to soil resources could occur at stream crossings; however, standard operating procedures would ensure that impacts to these soil resources would be not significant. Impacts to water quality from soil erosion could occur. The water quality impacts of this soil erosion are addressed in Section 3.3, Water Quality, and Section 3.6, Aquatics.

A limited amount of soil compaction would occur from right-of-way and facility maintenance. However, most maintenance trips would be conducted on existing or new permanent access roads.

3.8.6.4.2 Operation Impacts. The operation of the Proposed Action would affect creek channel and bank erosion in the Diamond Fork drainage. From 1915 to 1995, Strawberry Tunnel was used to divert water from Strawberry Reservoir to Sixth Water Creek. During the last two decades, the average maximum flows were approximately 300 cfs. The transbasin diversion through Strawberry Tunnel has been terminated, and Syar Tunnel and Sixth Water Aqueduct are now used for transbasin diversions. Currently, flow in Sixth Water Creek upstream of Sixth Water Aqueduct consists of approximately 7 cfs of discharge of seepage from Strawberry Tunnel plus some natural flow. Under these new conditions, erosion of soil from the base of soil slides into the creek bottom has been reduced and no longer contributes significant amounts of fine sediment to Sixth Water and Diamond Fork Creeks and the Spanish Fork River. Moreover, the reduced rate of erosion from the bottom of the slides has probably reduced the general rate of downhill soil creep at the slide areas. Downstream of Sixth Water Aqueduct, Sixth Water Creek conveys the transbasin diversion as in the past, producing the same flow rates.

Under the Proposed Action, upper Sixth Water Creek flows would be maintained at seasonal minimums of 25 and 32 cfs when the Strawberry Tunnel seepage and natural flow would be supplemented by water released from Strawberry Reservoir. This would increase the amount of soil washed from the base of slide areas along upper Sixth Water Creek. While this may slightly increase the general rate of downhill slippage at the slide areas, the effect of increased erosion on water quality and aquatic resource maintenance would be of greater concern than the localized impacts on soils.

Lower Sixth Water Creek flows would be sharply reduced under the Proposed Action. All of the transbasin flow from Strawberry Reservoir would flow through the "Diamond Fork Tunnel Alternative," and none would be released to Sixth Water Creek. Consequently, the flow of Sixth Water Creek below Sixth Water Aqueduct would consist only of minimum flow releases from Strawberry Tunnel, plus natural inflow occurring along the creek and from Fifth Water Creek. The decrease would sharply reduce stream bank erosion, soil destabilization, and loss of stream bank vegetation.

Along Diamond Fork Creek, less erosion would occur to the bed and banks of the creek because of the reduction in flows because most of the irrigation water for southern Utah and eastern Juab Counties would be conveyed in the Diamond Fork Pipeline.

3.8.6.4.3 Mitigation. Construction of the "Diamond Fork Tunnel Alternative" would be accompanied by special provisions to control soil erosion during construction. The area would be restored under a restoration program to be developed with the USFS. The restoration program would include provisions to limit soil erosion to the degree currently existing. The construction of the Main Conveyance Aqueduct and related actions would be controlled to avoid soil erosion. Otherwise, no further mitigation would be provided for impacts to soils.

3.8.6.4.4 Unavoidable Adverse Impacts. The unavoidable adverse impacts of the Proposed Action on soils would consist of some soil erosion from construction in the Diamond Fork drainage and increased erosion of soil from the upper Sixth Water Creek resulting from minimum flow releases through Strawberry Tunnel.

3.8.6.5 MCAPW-DFT Alternative

3.8.6.5.1 Construction Impacts. The construction of the Main Conveyance Aqueduct and local distribution systems in the MCAPW-DFT Alternative would cause similar impacts as described for the Proposed Action, except that construction of the turnout at the end of the Diamond Fork Pipeline and the discharge pipe to Diamond Fork Creek would disturb additional acreage of hydric soil. However, the turnout and pipeline would be constructed on former pasture land and would not be difficult to revegetate. The outlet of the turnout pipe to the creek would be designed to protect against scouring of the creek channel and banks. The Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct would be constructed partially on agricultural land in southern Utah Valley. The pipeline trench excavation and backfill would cause soil mixing and would have the potential to degrade agricultural qualities of the soil. This would be avoided by stockpiling and replacing topsoil excavated from agricultural land.

3.8.6.5.2 Operation Impacts. The operational impacts of the MCAPW-DFT Alternative Main Conveyance Aqueduct and local distribution systems would be the same as those described for the Proposed Action.

3.8.6.5.3 Mitigation. Mitigation for the MCAPW-DFT Alternative would include the same measures as described for the Proposed Action. In addition, the excavation and backfill of the trenches for the Salem Bench and Payson Pipelines crossing agricultural land would be accompanied by stockpiling and replacing topsoil.

3.8.6.5.4 Unavoidable Adverse Impacts. Unavoidable adverse impacts resulting from the MCAPW-DFT Alternative would be the same as those described for the Proposed Action.

3.8.6.6 MCAP Alternative

The MCAP Alternative would require construction of Monks Hollow Dam and Reservoir to complete the Diamond Fork System, the Main Conveyance Aqueduct, and associated facilities.

3.8.6.6.1 Construction Impacts. Construction of Monks Hollow Dam and Reservoir would be accompanied by diversion of Diamond Fork Creek around the work area and excavation to prepare the dam site for construction

of the concrete dam. The diversion system would be constructed to minimize soil erosion into the creek. The excavation for the foundation of the dam would be constructed in an dewatered section of the creek bottom. However, in spite of precautions, soil materials would be washed into the creek at times, particularly when the temporary creek diversion is established or modified as dam construction progresses.

Construction of the day-use recreation area at the reservoir and the access road on the north side of Diamond Fork Canyon would involve disturbance of these soils. There would be a potential for erosion of disturbed soil along the access road. This would be controlled by reseeding disturbed slopes to regain grass cover.

The impacts of the construction of the Main Conveyance Aqueduct and related actions would be the same as those described for the Proposed Action.

3.8.6.6.2 Operation Impacts. The operational impacts of the MCAP Alternative would consist primarily of increased erosion along Sixth Water Creek resulting from higher flows. Less erosion would occur to the bed and banks of Diamond Fork Creek because most irrigation water would be conveyed in the Diamond Fork Pipeline.

3.8.6.6.3 Mitigation. Provisions would be implemented to minimize soil erosion from the construction of Monks Hollow Dam. Disturbed areas with a potential for erosion at the dam site, along the access road, and along the Main Conveyance Aqueduct would be reseeded and stabilized.

3.8.6.6.4 Unavoidable Adverse Impacts. Increased soil erosion along Sixth Water Creek would be an unavoidable adverse impact under the MCAP Alternative.

3.8.6.7 MCAPW Alternative

Construction and operation impacts that would result from Monks Hollow Dam and Reservoir would be the same as those described under the MCAP Alternative. Impacts associated with the Main Conveyance Aqueduct would be the same as those described under the Proposed Action.

3.8.6.7.1 Mitigation. Mitigation measures would be the same as those described for the MCAP Alternative and would also include stockpiling of soil along the Salem Bench and Payson Pipeline construction alignment.

3.8.6.7.2 Unavoidable Adverse Impacts. Increased soil erosion from the banks of Sixth Water Creek would be an unavoidable adverse impact under the MCAPW Alternative.

3.8.6.8 MCATC Alternative

3.8.6.8.1 Construction Impacts. Aside from tunnel construction impacts (permanent acreage of approximately 1.6 acres) and the deposition of spoil material, potential impacts from the MCATC Alternative would be the same as those identified for the MCAP Alternative.

3.8.6.8.2 Operation Impacts. The impacts to soil resources anticipated with the MCATC Alternative are the same as those described for the MCAP Alternative.

3.8.6.8.3 Mitigation. Mitigation measures would be the same as those described for the MCAP Alternative.

3.8.6.8.4 Unavoidable Adverse Impacts. Increased soil erosion from the banks of Sixth Water Creek would be an unavoidable adverse impact.

3.8.6.9 MCAT Alternative

3.8.6.9.1 Construction Impacts. The construction impacts of the MCAT Alternative would be the same as those described for the MCATC Alternative except that construction of the turnout at the end of the Diamond Fork Pipeline and the Salem Bench and Payson Pipelines would cause the same impacts as those described for the Main Conveyance Aqueduct under the MCAPW-DFT Alternative.

3.8.6.9.2 Operation Impacts. The operation impacts would be the same as those described for the MCAP Alternative.

3.8.6.9.3 Mitigation. Mitigation measures would be the same as those described for the MCAP Alternative.

3.8.6.9.4 Unavoidable Adverse Impacts. Increased soil erosion from the banks of Sixth Water Creek would be an unavoidable adverse impact.

3.8.6.10 No Action Alternative

The SFN System No Action Alternative would result in the completion of the Diamond Fork System with Three Forks Dam and Reservoir, the 2.5-mile Diamond Fork Pipeline Extension, and a turnout on the Diamond Fork Pipeline. No SFN System facilities would be constructed. Bonneville Unit water from Strawberry Reservoir would be conveyed to Utah Lake and to irrigators in the Spanish Fork area through the Spanish Fork River.

3.8.6.10.1 Construction Impacts. Construction of Three Forks Dam and Reservoir would require the diversion of Diamond Fork Creek around the work area and excavation of the creek bottom to construct the dam foundation. The diversion system would be constructed to minimize soil erosion into the creek. The pipeline would also be constructed to avoid erosion. The excavation for the dam foundation would be conducted in a dewatered section of the creek bottom. However, in spite of precautions, soil materials would be washed into the creek at times, particularly when the temporary creek diversion would be established or modified as dam construction progressed.

3.8.6.10.2 Operation Impacts. The operational impacts of the No Action Alternative would consist primarily of increased erosion along Sixth Water Creek resulting from higher flows than occur at present. Less erosion would occur to the banks of Diamond Fork Creek because most of the transbasin diversion would be conveyed in the Diamond Fork Pipeline. This alternative would result in increased flows in the Spanish Fork River. These flows would result in increased stream bank erosion, which would be considered not significant, but an unavoidable adverse impact.

3.8.6.10.3 Mitigation. The potential for soil erosion during the construction of Three Forks Dam and the pipeline would be mitigated by appropriate measures.

3.8.6.10.4 Unavoidable Adverse Impacts. Increased soil erosion of the banks of Sixth Water Creek and Spanish Fork River would be an unavoidable adverse impact.

3.8.6.11 Summary of Impacts

A summary of impacts of the Proposed Action and the alternatives on soil resources is presented in Table 3.8-9. Construction impacts such as compaction, mixing, and increased erosion rates would occur to soils under each of the alternatives. Although the total amount of soil disturbed varies among the Proposed Action and the alternatives, the impacts would be similar. Implementation of the *Erosion Control, Revegetation, and Maintenance Plan* (Appendix A) would reduce these impacts to non-significant levels. Operation impacts of stream bank

erosion would result in some areas from increased streamflows and elevated groundwater levels under each of the alternatives.

Impacts caused by distribution system changes would be minimal with effective implementation of the *Erosion Control, Revegetation, and Maintenance Plan* (Appendix A) during and after construction. Rights-of-way would be revegetated after pipeline installation and would be expected to return to pre-construction densities and vigor. The 420 acres of land disturbance associated with the construction of the distribution system would be reclaimed.

Table 3.8-9
Summary of Impacts on Soil Resources

Page 1 of 2

Activity	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Construction	Soil erosion at "Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct construction sites.	Not significant	None	Not significant
Operation	Increased bank erosion along upper Sixth Water Creek.	Significant	None	Significant
	Reduction in bank erosion along lower Sixth Water and Diamond Fork Creeks.	Significant	None	Significant
MCAPW-DFT Alternative				
Construction	Soil erosion at "Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct construction sites.	Not significant	None	Not significant
	Mixing and compaction of agricultural soils along Salem Bench and Payson Pipelines.	Not significant	None	Not significant
Operation	Same as Proposed Action.			
MCAP, MCATC, and MCAT Alternatives				
Construction	Soil erosion from Monks Hollow Dam construction.	Not significant	None	Not significant
	Erosion from Main Conveyance Aqueduct construction.	Not significant	None	Not significant
Operation	Increased bank erosion along Sixth Water Creek.	Significant	None	Significant
	Reduction in bank erosion along lower Sixth Water and Diamond Fork Creeks.	Significant	None	Significant
MCAPW Alternative				
Construction	Soil erosion at "Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct construction sites.	Not significant	None	Not significant
	Erosion from Main Conveyance Aqueduct construction.	Not significant	None	Not significant
	Mixing and compaction of agricultural soils along Salem Bench and Payson Pipelines.	Not significant	None	Not significant
Operation	Same changes in creek erosion as Proposed Action.			

Table 3.8-9 Summary of Impacts on Soil Resources Page 1 of 2				
Activity	**Impact**	**Significance**	**Mitigation**	**Significance After Mitigation**
No Action Alternative				
Construction	Soil erosion from Three Forks Dam, pipeline, and road construction.	Not significant	None	Not significant
Operation	Increased bank erosion along Sixth Water Creek.	Significant	None	Significant
	Reduction in bank erosion along lower Sixth Water and Diamond Fork Creeks.	Significant	None	Significant
	Increased bank erosion along Spanish Fork River.	Significant	None	Significant

3.8.7 Cumulative Impacts

The soils of the SFN or Diamond Fork Systems would not be subjected to systematic impacts from the construction or operation of the projects identified in Section 1.8, except for the stream bank and channel erosion along Sixth Water and Diamond Fork Creeks, which varies with streamflow rate. Current summer flow rates in lower Sixth Water and Diamond Fork Creeks have been unnaturally high for decades because they convey the SVP transbasin diversion. The Sixth Water Creek and Diamond Fork Creek restoration plan being developed by the Mitigation Commission is intended to stabilize the channels of these creeks to control erosion and improve aquatic and riparian habitat.

The cessation of transbasin diversions through Strawberry Tunnel in 1996 has ended the unnaturally high flows in upper Sixth Water Creek. The restoration plan for lower Diamond Fork Creek is predicated upon the diversion of most of the future transbasin diversion into the Diamond Fork Pipeline, which the Proposed Action and all its alternatives include. The opportunity for restoration of lower Sixth Water Creek depends on bypassing transbasin diversion flows around its channel.

The Proposed Action and its alternatives vary in their contributions to the habitat stabilization and improvement objectives. The Proposed Action and the MCAPW-DFT Alternative would reduce the flows in those creeks to habitat conservation-oriented rates. The MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives would provide this benefit to upper Sixth Water and lower Diamond Fork Creeks. In general, the Proposed Action and all its alternatives would provide a net improvement in soil erosion along stream channels in the Diamond Fork drainage.

3.9 Agriculture

3.9.1 Introduction

This section addresses potential impacts to agriculture that would result from the construction, operation, and maintenance of the SFN System and related distribution and on-farm systems. The analysis focuses on potential impacts to agricultural practices and production caused by construction activities and by the increased irrigation water supply. Impacts to agricultural economics are addressed in Section 3.12, Socioeconomics.

3.9.2 Issues Eliminated from Further Analysis

Two issues raised during the SFN System scoping process have been eliminated from further analysis. These issues are 1) livestock routing around the Monks Hollow Dam and 2) conversion of agricultural land to non-agricultural uses.

Construction and management of those alternatives that include construction of the Monks Hollow Dam and Reservoir (MCAP, MCAPW, MCATC, and MCAT Alternatives) would have considerable impact on livestock management and routing. The proposed Monks Hollow Reservoir would inundate the Spanish Fork Livestock Association herder camps and corral and block the main artery for trailing cattle to various grazing units during the summer and fall. In total, approximately 760 acres of grazing land would no longer be available for that purpose. These issues were addressed in the *Diamond Fork Power System FEIS* (USBR 1984).

Conversion of agricultural lands to non-agricultural uses is not anticipated to occur as a result of the SFN System. Bonneville Unit water contracted for agricultural purposes could not be converted to municipal or industrial purposes without prior approval and contract modification through the CUWCD and additional environmental review. Potential growth impacts associated with the construction and operation of the SFN System are discussed in Section 3.12, Socioeconomics.

3.9.3 Issues Addressed in the Impact Analysis

The following sections describe issues that are addressed in the impact analysis.

3.9.3.1 Issues Raised During Scoping

During the public scoping process, impacts to agriculture as a result of potential changes to groundwater levels were raised as an issue.

3.9.3.2 Other Issues Raised

Issues not identified in scoping but included in this analysis are listed below:

- **Construction.** Impacts associated with the construction of the SFN System and distribution system facilities have been addressed in the analysis. Impacts resulting from construction could include reduced yields and interference with farm operations such as irrigation.

- **Changes in Amount and Quality of Production.** Changes in production, such as crop yields, would occur upon the completion of SFN System and distribution system facilities.

- **Conversions in the Type of Agricultural Production.** On-farm conversions from flood to sprinkler systems would enable changes in crop rotations and the conversion to higher value crop types. For

purposes of analysis, these changes are considered in conjunction with changes in the amount of production.

- **Changes to Prime Farmlands.** The Utah Agricultural Experiment Station and the NCRS have classified certain farmlands within southern Utah County as prime in accordance with national guidelines (Southard et al. 1980). These designations are indicators of the potential productivity of land. Many lands within the impact area of influence qualify for designation as prime, but currently do not meet the criteria because of insufficient water. Lands that would receive Bonneville Unit water would qualify for changes in classification.

3.9.4 Impact Area of Influence

The impact area of influence includes 79,950 acres of agricultural lands in southern Utah and eastern Juab Counties that are eligible to receive Bonneville Unit irrigation water (see Map 1-11). The impact area of influence also includes agricultural lands in the vicinity of proposed facilities that are not eligible to receive Bonneville Unit water, but could be affected by construction activities (e.g., Woodland Hills area).

3.9.5 Affected Environment

While there are 79,950 acres of eligible agricultural lands within the impact area of influence, as well as an adequate water supply available to serve all 79,950 eligible acres, a joint analysis effort by the CUWCD, NCRS, and Utah Division of Water Resources staff (Anderson, et al. 1996) estimated that 53,930 acres would most likely be eligible to purchase Bonneville Unit water. These 53,930 acres constitute an "expected affected acreage" for purposes of impact calculation. It does not, however, suggest in any way that only 53,930 acres (or any amount less than 79,950 acres) may receive project water. Irrigation demand is based on the 79,950 acres of eligible agricultural land in the impact area of influence. Agricultural lands are composed of various crop types, both irrigated and non-irrigated, including alfalfa, oats, barley, corn, and fruit. The amount of land in each crop type varies from year to year and has been estimated based on the general land area descriptions listed on Map 1-11.

Irrigation water supply adequacy is based on USBR shortage guidelines and considers the entire range of hydrologic conditions over a 44-year period, encompassing wet, dry, and average conditions. The crop production analysis is based on this water supply adequacy for the 53,930 acres of eligible agricultural lands that are likely to purchase Bonneville Unit water. Because of this, crop production estimates are not varied for dry, average, and wet conditions. In addition, agricultural product prices are not varied for dry, average, and wet conditions because of the uncertainty of market price fluctuations from year to year. It is recognized, however, that crop production and market prices are likely to move in opposite directions, exerting an overall influence toward an average total revenue. In other words, in dry years, product shortage is likely to increase prices and per unit revenues, offsetting reduced yield to some extent; and in wet years, product surplus is likely to decrease prices and per unit revenues, offsetting increased yield (to some extent).

The SFN System would deliver the same amount of Bonneville Unit water to agricultural lands in eastern Juab and southern Utah Counties under the Proposed Action and all of the alternatives except the No Action Alternative. However, water contracts between local irrigation companies and irrigators have not yet been completed, and as a result, the final design of the proposed distribution systems cannot be completed. Therefore, to identify the affected environment and conduct the impact analysis, "representative farms" were selected to depict the major agricultural land areas and crop types that could potentially be affected by the construction and operation of SFN System facilities under the Proposed Action or the other alternatives. A detailed description of how and why these representative farms were chosen is described in the On-Farm Representative Area Template (CUWCD 1998h) and is available from the CUWCD.

3.9.5.1 Agricultural Production

Brief summaries of crop type and irrigation methods for each of the general land area classifications are presented below. The descriptions identify current agricultural practices and crops for all 79,950 acres of agricultural lands eligible to receive Bonneville Unit water.

General Land Area 1: This land area (22,240 acres) is in southern Utah County. The majority of the area is irrigated with unimproved flood systems. This area is primarily planted in alfalfa (55 percent), with smaller acreages of barley (25 percent), corn grain (10 percent), and corn silage (10 percent).

General Land Area 2: This land area (15,910 acres) is in southern Utah County and is irrigated with unimproved flood systems. Crop production is similar to General Land Area 1, with a larger percentage of land in alfalfa (67 percent) and smaller percentages in barley (21 percent), corn grain (3 percent), corn silage (7 percent), and some oat hay (2 percent).

General Land Area 3: This land area (8,280 acres) is in southern Utah County. The area is planted in orchards of tart cherries (46 percent) and apples (54 percent). The orchards are primarily irrigated by sprinkler and minispray systems; some orchards are flood-irrigated.

General Land Area 3a: This land area (120 acres) is in southern Utah County. The area consists of grass and shrubs with the potential to be converted to orchards. Sprinkler irrigation would be required.

General Land Area 3a´: This land area (150 acres) is in southern Utah County. This area consists of alfalfa with the potential to be converted to orchards. Sprinkler irrigation would be required.

General Land Area 4: This land area (6,120 acres) is in eastern Juab County. The majority of the land is in unimproved flood-irrigation with some improved flood irrigation. Currently, this area is primarily planted to alfalfa (70 percent), with smaller amounts of barley (14 percent), corn silage (2 percent), and oat hay (14 percent).

General Land Area 5: This land area (10,680 acres) is also in eastern Juab County. Nearly all of the land is planted in wheat (90 percent), with a small amount in alfalfa (10 percent). This area has no irrigation and is farmed as winter wheat/summer fallow. From 1985 through 1988, approximately 21,667 acres in Juab County including the majority of the 10,680 acres in General Land Area 5 were entered into the Conservation Reserve Program (CRP) for a 10-year period. CRP is a crop reduction program through the U.S. Department of Agriculture (USDA) Farm Service Agency (FSA), formerly known as the Agricultural Stabilization and Conservation Service. Irrigators enter into a 10-year contract in which they agreed to seed or leave the land in permanent vegetation and not to hay or graze it for the 10-year contract period. In turn, the irrigator receives an annual payment from FSA. The contracts on 95 percent of the CRP acres expired at the end of 1997. It is anticipated that after 1998 this area would go to a rotation of winter wheat/summer fallow and dryland alfalfa.

General Land Area 6: This land area (6,270 acres) is in southern Utah County. The majority of the land is sprinkler irrigated (80 percent) and planted to a rotation of mostly alfalfa (60 percent), with smaller amounts of barley (20 percent), corn grain (10 percent), and corn silage (10 percent).

General Land Area 7: This land area (9,520 acres) occurs in both counties (69 percent, or 6,570 acres, in southern Utah County, and 31 percent, or 2,950 acres, in eastern Juab County). The land is mostly planted in alfalfa (79 percent), with smaller amounts in barley (7 percent), corn grain (2 percent), and corn silage (12 percent). Crop production varies from year to year.

General Land Area 8: This land area (660 acres) is in Juab County. The area consists of grass and small shrubs with the potential to be converted to alfalfa, small grain, and corn. Sprinkler irrigation systems would be required.

The distribution of crop types for the impact area of influence was used as a basis for estimating cropping patterns and production within the expected 53,930 acres that would be affected. Baseline cropping conditions for the 53,930 acres of agricultural lands that would be affected by operation of the SFN System, distribution facilities, and on-farm systems are presented in Table 3.9-1.

3.9.5.2 Special Designation Agricultural Lands

The USDA defines prime farmland as the land best suited to produce food, feed, forage, fiber, and oilseed crops. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when managed properly (USDA 1984). Specifically, prime farmlands are defined (Trickler 1996) as having the following characteristics:

- Cropland or pastureland that has sufficient precipitation for economical production or has a developed irrigation system with a water supply adequate to meet irrigation requirements in 8 of 10 years
- A mean annual soil temperature higher than 32°F and mean summer soil temperature higher than 59°F at a depth of 20 inches
- A pH value between 4.5 and 8.4 above a depth of 40 inches
- An exchangeable sodium percentage of less than 15 percent above a depth of 40 inches
- Salt content producing an electrical conductivity of less than 4 µmhos/cm above a depth of 40 inches
- A water table that does not restrict the production of food, feed, or forage crops common to the area
- Floods less often than once in 2 years
- Is not saturated for long periods of time during the growing season
- Has minimal erosion danger (i.e., K [soil erodibility factor] times percent slope is less than 2 and I [wind erodibility index] times C [climatic factor] does not exceed 60)
- Less than 10 percent of the upper 6 inches consists of rock fragments coarser than 3 inches

To meet the definition of prime farmland, an adequate water supply is needed. After reviewing the *Important Farmlands of Utah County Central Part* (Southard et al. 1980), the *Soil Survey of Fairfield-Nephi Area Utah* (USDA 1984), and water supply reports for the SFN System area, an estimation was made of the acres of prime farmland in the impact area of influence. For this analysis, NRCS staff identified prime farmlands with and without an adequate water supply, as shown in Table 3.9-2.

3.9.6 Impact Analysis

Potential impacts to agricultural resources have been categorized as either construction- or operation-related. For this analysis, operation impacts associated with the SFN System include the distribution and on-farm systems that would be constructed since all facilities would need to be in place to convey irrigation water to farmlands. Water delivery and operational impacts would be the same for the Proposed Action and each of the action alternatives.

Table 3.9-1
Annual Agricultural Production on Agricultural Lands Potentially Affected by the SFN System (Baseline Conditions)
Page 1 of 2

	Impact Area of Influence	Expected Affected Acreage	Alfalfa (ton)	Barley (bu)	Corn		Oat Hay (ton)	Tart Cherries (lb)	Apples (lb)	Dryland Winter Wheat/Summer Fallow (bu)
					Grain (bu)	Silage (ton)				
Southern Utah County										
General Land Area 1	22,240	12,600								
Percentage of Total Land[a]			55%	25%	10%	10%				
Acres[b]			6,930	3,150	1,260	1,260				
Yield/Acre[c]			4	95	100	20				
Yield[d]			27,720	299,250	126,000	25,200				
General Land Area 2	15,910	9,550								
Percentage of Total Land[a]			67%	21%	3%	7%	2%			
Acres[b]			6,399	2,006	287	669	191			
Yield/Acre[c]			3.5	95	100	20	2.5			
Yield[d]			22,395	190,570	28,650	13,380	478			
General Land Area 3	8,280	7,040								
Percentage of Total Land[a]								54%	46%	
Acres[b]								3,802	3,238	
Yield/Acre[c]								10,000	20,000	
Yield[d]								38,020,000	64,760,000	
General Land Area 3a	120	120								
Percentage of Total Land[a]										
Acres[b]										
Yield/Acre[c]										
Yield[d]										
General Land Area 3a´	150	150								
Percentage of Total Land[a]			70%							
Acres[b]			105							
Yield/Acre[c]			2.0							
Yield[d]			210							
General Land Area 6	6,270	1,890								
Percentage of Total Land[a]			60%	20%	10%	10%				
Acres[b]			1,134	378	189	189				
Yield/Acre[c]			4.5	90	100	25				
Yield[d]			5,103	34,020	18,900	4,725				
Yield[d]			13,480	26,820	8,500	10,240				
General Land Area 7 Sprinkler Irrigated Rotational Cropland	6,570	4,265								
Percentage of Total Land[a]			79%	7%	2%	12%				
Acres[b]			3,370	298	85	512				
Yield/Acre[c]			4	90	100	20				
Total Crop Yield (Southern Utah County)			68,908	550,660	182,050	53,545	478	38,020,000	64,760,000	0

Table 3.9-1
Annual Agricultural Production on Agricultural Lands Potentially Affected by the SFN System (Baseline Conditions)
Page 2 of 2

	Impact Area of Influence	Expected Affected Acreage	Alfalfa (ton)	Barley (bu)	Corn		Oat Hay (ton)	Tart Cherries (lb)	Apples (lb)	Dryland Winter Wheat/Summer Fallow (bu)
					Grain (bu)	Silage (ton)				
Eastern Juab County										
General Land Area 8	660	660								
Percentage of Total Land[a]										
Acres[b]										
Yield/Acre[c]										
Yield[d]										
General Land Area 4	6,120	6,120								
Percentage of Total Land[a]			70%	14%		2%	14%			
Acres[b]			4,284	857		122	857			
Yield/Acre[c]			3.5	85		20	2.5			
Yield[d]			14,994	72,828		2,448	2,142			
General Land Area 5[e]	10,680	9,610								
Percentage of Total Land[a]			10%							25%
Acres[b]			961							2,670
Yield/Acre[c]			1.25							25[f]
Yield[d]			1,201							33,375
General Land Area 7	2,950									
Sprinkler Irrigated Rotational Cropland		1,925								
Percentage of Total Land[a]			79%	7%	2%	12%				
Acres[b]			1,521	135	38	231				
Yield/Acre[c]			4	90	100	20				
Yield[d]			6,084	12,150	3,800	4,620				
Total Crop Yield (Eastern Juab County)			**22,279**	**84,978**	**3,800**	**7,068**	**2,142**	**0**	**0**	**33,375**
Total Acreage	**79,950**	**53,930**								
Total Crop Yield (Both Counties)			**91,187**	**635,638**	**185,850**	**60,613**	**2,620**	**38,020,000**	**64,760,000**	**33,375**

[a]Estimate of percentage of total affected acreage of crop production provided by NRCS and the Utah Division of Water Resources.
[b]Estimated percentage acreage multiplied by expected affected acreage.
[c]From NRCS and CUWCD representative farm survey. Yield per acre represents average production for fully irrigated lands in crop category.
[d]Annual yields on affected lands vary depending upon available water supplies.
[e]Subject to CRP; see discussion of CRP under description of General Land Area 5.
[f]Yield is realized every other year.

Table 3.9-2 Changes in Prime Farmland in SFN System Area (acres)				
County	**Total Prime Farmland Estimated to Receive a Full Water Supply Under SFN System Conditions**	**Existing Prime Farmland with Adequate Water Supply**	**Additional Prime Farmland as a Result of the SFN System**	**Percentage Increase in Prime Farmland**
Utah	27,790	17,120	10,670	62%
Juab	20,338	5,000	15,338*	307%
Total	**48,128**	**22,120**	**26,008**	**188%**

*8,500 acres are presently dry farmland.
Source: Anderson 1996a

3.9.6.1 Significance Criteria

The significance criteria used to evaluate impacts on agricultural resources are based on professional judgement and involvement in other projects subject to NEPA provisions. Potential impacts to the agricultural sector from construction and operation of the SFN System were analyzed relative to effects on agricultural practices and production. Identified below are the criteria used to determine whether impacts to agricultural resources would be significant.

For individual irrigators, impacts could be potentially significant if construction activities would cause a substantial disruption of farming practices or substantial reduction in yield. For this study, an impact to individual irrigators would be considered significant if construction or operation would result in individual farm production changes greater than 10 percent.

Potentially significant impacts could also occur if substantial changes occur to agricultural production within Utah and Juab Counties. For this study, an impact to agricultural production would be considered significant if construction or operation would result in a change in crop production greater than 10 percent.

Prime agricultural lands are indicators of the most productive lands. Changes in the amount of prime agricultural lands, therefore, would also be an indicator of the significance of SFN System impacts on agriculture. For this study, an impact to prime agricultural lands in the region would be considered significant if construction or operation would result in a change in prime agricultural lands greater than 10 percent.

3.9.6.2 Potential Impacts Eliminated from Further Analysis

Based on water resources, water quality, and wetland resources analyses, certain agricultural impacts would not be expected to occur. Potential agricultural impacts eliminated from further analysis are described below.

- Increased irrigation and use of return flows could affect the quality of water supplies for downstream agricultural water users. A determination was made that such changes would maintain water quality within State of Utah standards and would not substantially affect agricultural production (see Section 3.2, Water Resources, and Section 3.3, Water Quality).
- Increased irrigation could increase groundwater flow through mineral-bearing geologic formations that could increase mineral concentrations in surface water and groundwater used for agriculture. A determination was made that no substantial changes in water quality would occur because such flow

increases would not contain mineral concentrations (see Section 3.2, Water Resources, and Section 3.3, Water Quality).

- Increased irrigation could increase flows from existing seeps and wetlands that could impact farming practices and production. A determination was made that any predicted increase in spring discharge would occur in existing wetlands and non-agricultural lands classified as 6A and would not impact eligible agricultural lands (see Section 3.4, Wetland Resources).

- Increased irrigation could raise groundwater levels resulting from new areas of seeps and wetlands or encroachment into the root zone of crops produced in shallow groundwater areas. A determination was made that substantial increases in groundwater levels would occur in both counties. Such changes would not impact agricultural production because the increased groundwater levels would not encroach on the root zone of agricultural production areas and because the flows from such seeps and wetlands are geologically constrained (see Section 3.2, Water Resources).

- Construction and operation of M&I distribution systems would not have an impact on agricultural production because M&I systems would not remove agricultural lands from production and would have a separate, designated water supply.

- Construction of the "Diamond Fork Tunnel Alternative" under the Proposed Action and MCAPW-DFT Alternative would not affect agricultural lands within the impact area of influence and are therefore not included in the impact analysis.

3.9.6.3 Proposed Action

Potential impacts to agricultural practices and production that would result from the construction and operation of the Proposed Action are presented in this section. These impacts are summarized in Section 3.9.6.10.

3.9.6.3.1 Construction Impacts. The number of acres of temporary and permanent impacts to agricultural lands in the impact area of influence for both the SFN System and related distribution systems is shown in Table 3.9-3. Construction disturbance to non-irrigated, cultivated farmland (dry-farmed), irrigated orchard, and other irrigated farmland is also shown in Table 3.9-3.

In general, impacts to agricultural practices and productivity as a result of construction activities would range from temporary interference with farm operations (e.g., cultivation and irrigation) to interim or permanent removal of orchard trees along the pipeline construction easement. Potential construction impacts would be greatest to orchards where trees would be removed and least to non-irrigated farmland where impacts would be limited to the duration of construction and the width of the right-of-way. In particular, potential impacts to orchards could occur where the pipeline would deviate from the High Line Canal in southern Utah County. Such impacts could also result in segmenting cultivated lands.

The proposed location of the Main Conveyance Aqueduct and related distribution pipelines for the Proposed Action is shown on Map 1-4. Up to 600 linear feet (about 3 acres total, assuming a 200-foot-wide easement) of the Main Conveyance Aqueduct construction easement would be subject to construction activities at any given time. Construction of the distribution system would be staged to follow completed segments of the Main Conveyance Aqueduct. As proposed, the pipeline would be constructed in segments each year from 1999 to 2008. This would mean that the 422 acres of temporary disturbance to agricultural lands in southern Utah County and the 163 acres of temporary disturbance in eastern Juab County would occur over a period of several years. Following completion of construction, the areas temporarily disturbed would be restored to pre-construction conditions (with the exception of orchards where a 100-foot-wide easement would be maintained free of trees).

Table 3.9-3
Agricultural Land Disturbance from Construction of SFN System Facilities and Related Actions Under the Proposed Action and All Other Action Alternatives[a] (acres)
Page 1 of 2

	Southern Utah County						Eastern Juab County					
	Main Conveyance Aqueduct and Associated Facilities[b]		Distribution Systems[b]		Total		Main Conveyance Aqueduct and Associated Facilities[b]		Distribution Systems[b]		Total	
	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent
Proposed Action												
Non-Irrigated	22.0	3.3	25.3	0.0	47.3	3.3	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	42.9	21.5	10.1	5.1	53.0	26.6	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	65.7	8.7	256.4	0.0	322.1	8.7	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	130.6	33.5	291.8	5.1	422.4	38.6	91.4	0.0	71.3	0.0	162.7	0.0
MCAPW-DFT Alternative												
Non-Irrigated	22.0	3.3	25.3	0.0	47.3	3.3	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	82.3	41.2	10.1	5.1	92.4	46.3	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	172.9	8.7	256.4	0.0	429.3	8.7	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	277.2	53.2	291.8	5.1	569.0	58.3	91.4	0.0	71.3	0.0	162.7	0.0
MCAP Alternative												
Non-Irrigated	22.0	3.3	25.3	0.0	47.3	3.3	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	42.9	21.5	10.1	5.1	53.0	26.6	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	65.7	8.7	256.4	0.0	322.1	8.7	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	130.6	33.5	291.8	5.1	422.4	38.6	91.4	0.0	71.3	0.0	162.7	0.0

Table 3.9-3
Agricultural Land Disturbance from Construction of SFN System Facilities and Related Actions Under the Proposed Action and All Other Action Alternatives[a] (acres)
Page 2 of 2

	Southern Utah County						Eastern Juab County					
	Main Conveyance Aqueduct and Associated Facilities[b]		Distribution Systems[b]		Total		Main Conveyance Aqueduct and Associated Facilities[b]		Distribution Systems[b]		Total	
	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent
MCAPW Alternative												
Non-Irrigated	22.0	3.3	25.3	0.0	47.3	3.3	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	82.3	41.2	10.1	5.1	92.4	46.3	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	172.9	8.7	256.4	0.0	429.3	8.7	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	277.2	53.2	291.8	5.1	569.0	58.3	91.4	0.0	71.3	0.0	162.7	0.0
MCATC Alternative												
Non-Irrigated	27.5	0.0	27.0	0.0	54.5	0.0	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	0.2	0.1	29.7	14.9	29.9	15.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	23.9	0.0	283.2	0.0	307.1	0.0	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	51.6	0.1	339.9	14.9	391.5	15.0	91.4	0.0	71.3	0.0	162.7	0.0
MCAT Alternative												
Non-Irrigated	27.5	0.0	0.0	0.0	27.5	0.0	17.8	0.0	71.3	0.0	89.1	0.0
Orchard	0.2	0.1	1.9	1.0	2.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Other Irrigated	23.9	0.0	10.2	0.0	34.1	0.0	73.6	0.0	0.0	0.0	73.6	0.0
Total Acres	51.6	0.1	12.1	1.0	63.7	1.1	91.4	0.0	71.3	0.0	162.7	0.0

[a]Excludes rangeland. Acreages assume no previous disturbance at SFN System and distribution system proposed locations. Temporary impacts apply to the year of construction except for orchard.
[b]See Maps 1-4, 1-7, 1-9, and 1-10 for the proposed alternative locations of the Main Conveyance Aqueduct and proposed local development facilities.

Assuming an average construction disturbance of approximately 4 linear miles (about 100 acres total, assuming a 200-foot-wide easement), negligible impacts to agricultural productivity would occur from a regional perspective since there are 79,950 acres of agricultural land in the impact area of influence.

The average farm size in the southern Utah County portion of the impact area of influence is about 40 acres, while the average farm size in the eastern Juab County portion is about 60 acres (Anderson 1996b). If the pipeline were to pass directly through the full length of a square plot of farmland 40 acres in size, approximately 6 acres of land would be temporarily disturbed. If that land were orchard and the 100-foot easement needed to be maintained free of trees, about 3 acres would be permanently disturbed. If the pipeline ran directly through the full length of a square plot of farmland 60 acres in size, approximately 7.5 acres of land would be temporarily disturbed. No land in eastern Juab County is expected to be permanently disturbed.

When these impacts are considered with the assumption that linear construction activities across individual farms would also impact cultivation, irrigation, and harvest operations beyond the construction right-of-way because of the segmentation of fields or orchards, impacts on an individual farm basis would be significant. Standard operating procedures have been adopted that require construction contractors to provide special measures to maintain access, irrigation, and other farming operations on the right-of-way and on farmlands segmented by construction activity. These measures would minimize the extent of impacts, but significant temporary impacts would still be anticipated.

3.9.6.3.2 Operation Impacts. Operation impacts resulting from the Proposed Action include changes in the amount of production (including conversions in the type of agricultural production) and changes to prime agricultural lands. These potential impacts are addressed below.

3.9.6.3.2.1 Changes in Agricultural Production. Changes in agricultural production would result from delivery of water supplies in addition to those which are currently available. The amount and type of agricultural production in southern Utah and eastern Juab Counties that would likely occur as a result of the Proposed Action are shown in Table 3.9-4. The amount of annual production as a result of the Proposed Action compared to baseline conditions for individual farms on a yield per acre basis are shown in Table 3.9-5. The change in annual production under the Proposed Action compared to baseline conditions (see Table 3.9-1) for the expected affected area is shown in Table 3.9-6.

The production impacts shown in Table 3.9-6 represent estimated average changes in production at individual farms in response to an increased water supply. Significant impacts would occur to all crop types.

Changes in the percentage distribution of crop production amounts (i.e., changes in percentage of total land between Tables 3.9-1 and 3.9-4) are anticipated for nearly all of the general land areas presented on Map 1-11 and summarized in Section 3.9.5.1. The anticipated conversions in crop types are summarized below.

General Land Area 1: Farmland production on 12,600 acres in General Land Area 1 (22,240 acres) would include minor changes in alfalfa (increase of 5 percent), moderate conversions from barley (decrease of 15 percent) and corn grain (increase of 10 percent), and no change in corn silage.

General Land Area 2: Farmland production on 9,550 acres in General Land Area 2 (15,910 acres) would include minor changes in alfalfa (increase of 5 percent), corn grain (increase of 1 percent), and oat hay (increase of 3 percent). It would also include a moderate change in the production of barley (decrease of 10 percent).

General Land Area 3: Farmland production on 7,040 acres in General Land Area 3 (8,280 acres) would include minor changes in both tart cherries (decrease of 4 percent) and apples (increase of 4 percent).

Table 3.9-4
Estimated Yield Changes in Farm Productivity (yield/acre/year)

	Utah County				Juab County			
	Baseline*	With SFN System	Change in Production	Percent Change	Baseline*	With SFN System	Change in Production	Percent Change
Alfalfa (tons)	4.0	5.5	+1.5	+38	3.5	5.0	+1.5	+43
Barley (bu)	90.0	110.0	+20.0	+22	85.0	100.0	+15.0	+18
Corn Grain (bu)	100.0	130.0	+30.0	+30	100.0	145.0	+45.0	+45
Corn Silage (tons)	20.0	30.0	+10.0	+50	20.0	26.0	+6.0	+30
Oat Hay (tons)	2.5	3.0	+0.5	+20	2.5	3.0	+0.5	+20
Cherries (lb)	10,000.0	12,000.0	+2,000.0	+20	NA	NA	NA	NA
Apples (lb)	20,000.0	24,000.0	+4,000.0	+20	NA	NA	NA	NA

*Approximate average production of expected affected area (see Table 3.9-1)
NA = not applicable

General Land Area 3a: All of General Land Area 3a (120 acres) would convert to tart cherries (60 acres or 50 percent) and apples (60 acres or 50 percent).

General Land Area 3a´: A majority of General Land Area 3a´ (150 acres) farmland production would include changes in alfalfa (decrease from 71 percent to 20 percent) and the addition of tart cherries (increase from zero to 40 percent) and apples (increase from zero to 40 percent).

General Land Area 4: In General Land Area 4 (6,120 acres), farmland production on the entire acreage would include minor changes to alfalfa (increase of 5 percent), barley (increase of 1 percent), and corn silage (increase of 3 percent). It would also include a moderate change in production of oat hay (decrease of 9 percent).

General Land Area 5: Farmland production on 9,610 acres in General Land Area 5 (10,680 acres) would include major changes in alfalfa (increase of 65 percent) and the addition of barley (15 percent), corn silage (5 percent) and oat hay (5 percent).

General Land Area 6: Farmland production on 1,890 acres in General Land Area 6 (6,270 acres) include minor changes in alfalfa (increase of 5 percent) and corn grain (increase of 3 percent), moderate changes in barley (decrease of 10 percent), the addition of oat hay (2 percent), and no change in corn silage.

General Land Area 7: The 4,265 acres of this land area (9,520 acres) would not be expected to change substantially from baseline conditions.

General Land Area 8: All of this land area (660 acres) would convert to alfalfa (75 percent), barley (20 percent), and oat hay (5 percent).

The significance of the projected impacts to agricultural production on a countywide basis is shown in Table 3.9-7. Increased yields are anticipated for all crop categories (combined counties) that would continue to be farmed, except barley and oat hay. Total barley production is expected to decrease by 6 percent and total oat hay production is expected to decrease by 7 percent (see Table 3.9-6).

Table 3.9-5
Agricultural Production per Year Resulting from the Proposed Action and All Action Alternatives

Page 1 of 2

	Expected Affected Acreage	Alfalfa (ton)	Barley (bu)	Corn		Oat Hay (ton)	Tart Cherries (lb)	Apples (lb)
				Grain (bu)	Silage (ton)			
Southern Utah County								
General Land Area 1	12,600							
Percentage of Total Land[a]		60%	10%	10%	20%			
Acres		7,560	1,260	1,260	2,520			
Yield/Acre[b]		5.5	110	130	30			
Yield[c]		41,580	138,600	163,800	75,600			
General Land Area 2	9,550							
Percentage of Total Land[a]		72%	11%	4%	8%	5%		
Acres		6,876	1,051	382	764	478		
Yield/Acre[b]		5.5	110	130	30	3		
Yield[c]		37,818	115,555	49,660	22,920	1,433		
General Land Area 3	7,040							
Percentage of Total Land[a]							50%	50%
Acres							3,520	3,520
Yield/Acre[b]							12,000	24,000
Yield[c]							42,240,000	84,480,000
General Land Area 3a	120							
Percentage of Total Land[a]							50%	50%
Acres							60	60
Yield/Acre[b]							12,000	24,000
Yield[c]							720,000	1,440,000
General Land Area 3a´	150							
Percentage of Total Land[a]		20%					40%	40%
Acres		30					60	60
Yield/Acre[b]		5.5					12,000	24,000
Yield[c]		165					720,000	1,440,000
General Land Area 6	1,890							
Percentage of Total Land[a]		65%	10%	13%	10%	2%		
Acres		1,229	189	246	189	38		
Yield/Acre[b]		6	115	130	30	3.5		
Yield[c]		7,371	21,735	31,941	5,670	132		
General Land Area 7								
Sprinkler Irrigated Rotational	4,265							
Cropland		79%	7%	2%	12%			
Percentage of Total Land[a]		3,370	298	85	512			
Acres		6	120	145	30			
Yield/Acre[b]								
Yield[c]		20,220	35,760	12,325	15,360			
Total Crop Yield (Southern Utah County)		**107,154**	**311,650**	**257,726**	**119,550**	**1,565**	**43,680,000**	**87,360,000**

Table 3.9-5
Agricultural Production per Year Resulting from the Proposed Action and All Action Alternatives

Page 2 of 2

	Expected Affected Acreage	Alfalfa (ton)	Barley (bu)	Corn Grain (bu)	Corn Silage (ton)	Oat Hay (ton)	Tart Cherries (lb)	Apples (lb)
Eastern Juab County								
General Land Area 8	660							
Percentage of Total Land[a]		75%	20%			5%		
Acres		495	132			33		
Yield/Acre[b]		5.0	100			2.6		
Yield[c]		2,475	13,200			86		
General Land Area 4	6,120							
Percentage of Total Land[a]		75%	15%		5%	5%		
Acres		4,590	918		306	306		
Yield/Acre[b]		5.5	110		26	3		
Yield[c]		25,245	100,980		7,956	918		
General Land Area 5	9,610							
Percentage of Total Land[a]		75%	15%		5%	5%		
Acres		7,208	1,442		481	481		
Yield/Acre[b]		5.5	110		26	3		
Yield[c]		39,641	158,565		12,506	1,442		
General Land Area 7								
Sprinkler Irrigated Rotational	1,925							
Cropland		79%	7%	2%	12%			
Percentage of Total Land[a]		1,521	135	38	231			
Acres		6	120	145	26			
Yield/Acre[b]								
Yield[c]		9,126	16,200	5,510	6,006			
Total Crop Yield (Eastern Juab County)		**76,487**	**293,945**	**5,510**	**26,468**	**2,446**	**0**	**0**
Total Expected Affected Acreage	**53,930**							
Total Crop Yield (Both Counties)		**183,641**	**605,595**	**263,236**	**146,018**	**4,011**	**43,680,000**	**87,360,000**

[a]Estimate of percentage of total expected affected acreage of crop production provided by NRCS and the Utah Division of Water Resources.
[b]From NRCS and CUWCD representative farm survey. Yield per acre represents average production for fully irrigated lands in crop category.
[c]Annual yields on affected lands vary, depending upon available water supplies.

Table 3.9-6
Analysis of Agricultural Production Impacts per Year to Expected Affected Area Resulting from the Proposed Action and All Action Alternatives

Crop	Southern Utah County				Eastern Juab County				Expected Affected Area Total			
	Baseline[a]	Proposed Action and Alternatives[b]	Change In Production	Percent Change	Baseline	Proposed Action and Alternatives	Change In Production[c]	Percent Change	Baseline	Proposed Action and Alternatives	Change in Production	Percent Change
Alfalfa (tons)	68,908	107,154	+38,246	+56	22,279	76,487	+54,208	+243	91,187	183,641	+92,454	+101
Barley (bu)	550,660	311,650	-239,010	-43	84,978	288,945	+203,967	+240	635,638	600,595	-35,043	-6
Corn Grain (bu)	182,050	257,726	+75,676	+42	3,800	5,510	+1,710	+45	185,850	263,236	+77,386	+42
Corn Silage (ton)	53,545	119,550	+66,005	+123	7,068	26,468	+19,400	+274	60,613	146,018	+85,405	+141
Oat Hay (ton)	478	1,565	+1,087	+227	2,142	2,446	+304	+14	2,620	2,446	-194	-7
Tart Cherries (lb)	38,020,000	43,680,000	+5,660,000	+15	0	0	0	0	38,020,000	43,680,000	+5,660,000	+15
Apples (lb)	64,760,000	87,360,000	+22,600,000	+35	0	0	0	0	64,760,000	87,360,000	+22,600,000	+35

[a]Table 3.9-1
[b]Table 3.9-5
[c]Anticipated changes in production in eastern Juab County are largely attributed to conversion from dryland farming to irrigated farming.

Table 3.9-7
Significance of Impacts in Agricultural Productivity by County/Year Resulting from Operation of the Proposed Action[a]

	Utah County Baseline[b]	Utah County	Change in Production	Percent Change	Juab County Baseline[b]	Juab County[c]	Change in Production	Percent Change
Alfalfa (tons)	139,300	177,546	+38,246	+27	54,200	108,408	+54,208	+100
Barley (bu)	1,021,000	781,990	-239,010	-23	135,000	338,967	+203,967	+151
Corn Grain (bu)	545,900	621,576	+75,676	+14	8,000	9,710	+1,710	+21
Corn Silage (ton)	178,100	244,105	+66,005	+37	11,400	30,800	+19,400	+170
Oat Hay (ton)	6,965	8,052	+1,087	+16	2,710	3,014	+304	+11
Tart Cherries (lb)	26,400,000	32,060,000	+5,660,000	+21	NA	NA	NA	NA
Apples (lb)	41,892,400	64,492,400	+22,600,000	+54	NA	NA	NA	NA

[a]Represents conditions for the Proposed Action and the alternatives as shown on Table 3.9-6. Shaded cells indicate significant impacts.
[b]See Table 3.9-1.
[c]Anticipated changes in agricultural production in Juab County are largely attributed to converting dryland farming to irrigated farming.

In Utah County, significant impacts from the operation of the SFN System are expected for production of all crops. Alfalfa, corn grain, corn silage, oat hay, tart cherries, and apples would all increase more than 10 percent. Barley production would decrease by more than 10 percent.

In Juab County, relatively more significant positive impacts are anticipated, with very large changes expected in alfalfa (increase of 100 percent), barley (increase of 151 percent), and corn silage (increase of 170 percent). The magnitude of these changes in Juab County can be attributed to the large number of acres (10,270 acres) that are anticipated to convert from dryland farming to irrigated farming.

The significant increase in agricultural production would be expected to lead to an increase in fertilizer and pesticide use. Potential effects on water quality from increased fertilizer use were determined to be not significant (as described in Section 3.3, Water Quality). Increased irrigation would result in some changes in the type and amount of pesticide use resulting from anticipated changes in crop type (i.e., changes from dryland winter wheat/ summer fallow rotation to irrigated alfalfa and small grains). Changes in pesticide use that would likely occur are a reduction of herbicide use for annual weed control in small grains and an increase in pesticide use to control weevil in alfalfa. The need to control weevil varies from year to year and not all irrigators spray to maintain control. Chemicals would be applied according to labels and regulations. Significant impacts to water quality resulting from pesticide use are not expected.

3.9.6.3.2.2 Changes in Prime Agricultural Lands. Water provided as a result of the Proposed Action would consist of supplemental irrigation supplies to areas within both counties and full water supplies to portions of eastern Juab County. These supplies would affect prime agricultural lands in both counties. Currently, an adequate and reliable water supply is the one criterion limiting certain lands from being classified as prime in portions of both counties (Anderson 1996a).

The anticipated impact on prime lands in the impact area of influence as a result of the Proposed Action are shown in Table 3.9-2. The most significant change would be on Juab County farmlands where substantial amounts of

agricultural lands would qualify for designation as prime farmland as a result of reliable water supplies provided by the SFN System.

3.9.6.3.3 Mitigation. No mitigation would be required under the Proposed Action.

3.9.6.3.4 Unavoidable Adverse Impacts. Unavoidable temporary adverse impacts would occur to agricultural operations and production on a limited number of individual farms in the vicinity of construction activities for the SFN System and distribution system facilities. Permanent reductions in barley production are also projected to occur in southern Utah County.

3.9.6.4 MCAPW-DFT Alternative

Impacts associated with the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action, except as noted blow.

3.9.6.4.1 Construction Impacts. The number of acres of temporary and permanent disturbances to agricultural lands resulting from construction of the MCAPW-DFT Alternative are shown in Table 3.9-3. There are no differences in impacts to eastern Juab County with this alternative as compared to the Proposed Action. The MCAPW-DFT Alternative would impact substantially more agricultural land in southern Utah County than the Proposed Action as a result of constructing the Main Conveyance Aqueduct outside the High Line Canal right-of-way. As a result, temporary disturbance of orchards would increase from 53.0 to 92.4 acres. Permanent disturbance of other irrigated lands would increase from 26.6 to 46.3 acres, and temporary disturbance of other irrigated lands would increase from 322.1 to 429.3 acres. No additional permanent disturbance would occur to other irrigated lands. There would be no additional temporary or permanent disturbance to non-irrigated lands.

Temporary impacts from construction of the MCAPW-DFT Alternative would not be a significant impact. On an individual farm basis, there is a slightly greater likelihood for temporary adverse impacts; and as with the Proposed Action, these impacts would be considered significant to individual farms.

3.9.6.4.2 Operation Impacts. Operation impacts resulting from the MCAPW-DFT Alternative would include the same changes to agricultural production and prime farmland as those described for the Proposed Action.

3.9.6.4.3 Mitigation. No mitigation would be required for the MCAPW-DFT Alternative.

3.9.6.4.4 Unavoidable Adverse Impacts. Unavoidable temporary adverse impacts would be slightly larger than those described for the Proposed Action.

3.9.6.5 MCAP Alternative

Impacts associated with the MCAP Alternative would be the same as those identified for the Proposed Action.

3.9.6.6 MCAPW Alternative

Impacts associated with the MCAPW Alternative would be the same as those identified for the MCAPW-DFT Alternative.

3.9.6.7 MCATC Alternative

The following sections describe construction- and operation-related impacts that would result from the MCATC Alternative. These impacts are summarized in Section 3.9.6.10.

Potential impacts resulting from the MCATC Alternative would be similar to impacts described for the Proposed Action. The timing of construction and of water supply deliveries to farms, distribution systems, on-farm systems and associated features would all be essentially the same, with the exception of the location of the SFN System and interconnecting segments of the distribution system facilities.

3.9.6.7.1 Construction Impacts. The number of acres of temporary and permanent impacts to agricultural lands by area resulting from construction of the MCATC Alternative is shown in Table 3.9-3. As compared to the Proposed Action, fewer orchard impacts (about 30 acres versus 53 acres) and less disturbance to other irrigated lands (307 acres versus 322 acres) would occur under the MCATC Alternative. Additional impacts (55 acres versus 47 acres) would occur to non-irrigated farmland, and substantially less permanent disturbance would occur (15 acres versus 39 acres).

Temporary impacts from construction of the MCATC Alternative would not represent a significant impact to the impact area of influence. On an individual farm basis, there would be a similar likelihood for temporary adverse impacts. As with the Proposed Action, these impacts would be considered significant to individual farms.

3.9.6.7.2 Operation Impacts. Operation impacts resulting from the MCATC Alternative would include the same changes to agricultural production and prime farmland as those described for the Proposed Action.

3.9.6.7.3 Mitigation. No mitigation would be required for the MCATC Alternative.

3.9.6.7.4 Unavoidable Adverse Impacts. Unavoidable temporary adverse impacts would be essentially the same as those described for the Proposed Action.

3.9.6.8 MCAT Alternative

The following sections describe construction- and operation-related impacts resulting from the MCAT Alternative. These impacts are summarized in Section 3.9.6.10.

Potential impacts resulting from the MCAT Alternative would be substantially different for construction, but essentially the same as described for the operation of the Proposed Action and MCATC Alternative. The SFN System facilities would be the same as described for the MCATC Alternative, but there would be a large reduction in distribution system facilities impacts, thereby significantly reducing disturbance to irrigated agriculture in southern Utah County.

3.9.6.8.1 Construction Impacts. The number of acres of temporary and permanent impacts to agricultural lands that would result from the MCAT Alternative are shown in Table 3.9-3. As with the MCATC Alternative, there would be no differences in impacts to eastern Juab County resulting from the MCAT Alternative. The MCAT Alternative would temporarily impact significantly less agricultural land (63 acres versus about 400 acres) in southern Utah County because there would be fewer distribution irrigation systems. As with the Proposed Action and the MCATC Alternative, impacts would still be considered significant to individual farms in the project area.

3.9.6.8.2 Operation Impacts. Operation impacts resulting from the MCAT Alternative would include changes to agricultural production and prime farmland similar to those described for the Proposed Action.

3.9.6.8.3 Mitigation. No mitigation would be required under the MCAT Alternative.

3.9.6.8.4 Unavoidable Adverse Impacts. There would be fewer instances of unavoidable temporary adverse impacts to individual farms during construction of the MCAT Alternative than described for the Proposed Action and MCATC Alternative. For individually affected farms, however, the impacts would still be significant.

3.9.6.9 No Action Alternative

Under the No Action Alternative, 3,500 acre-feet of water would be available for irrigation in southern Utah County, resulting in a slight beneficial impact to agricultural productivity in the area. However, most of southern Utah County and eastern Juab County would continue to be unable to meet demands for full irrigation season water supplies. Shortages in water supply to agriculture would continue to worsen because of the projected increases in demands and the priority of M&I uses. As a result, the current impacts of insufficient water supplies on agricultural production would be compounded over time. Productivity levels of prime farmlands, now limited only by insufficient water supplies, would also continue to be diminished.

In addition to the above, the No Action Alternative would affect future irrigation practices and on-farm irrigation efficiencies. Planned distribution system and irrigation efficiency improvements would not occur, thereby losing the opportunity to conserve and put to beneficial use substantial amounts of limited water supplies.

Further, other sectors of the agricultural industry (e.g., livestock) directly tied to local agricultural production would be indirectly affected. Under the No Action Alternative, increasing water supply shortages could begin limiting livestock food production, thereby creating shortages in the availability of winter feed and ultimately livestock products in the region.

One region of southern Utah County north of the Spanish Fork River in the vicinity of Mapleton and Spanish Fork would receive some supplemental water supplies under the No Action Alternative as described in Chapter 1. Such increased supplies would probably result in some increased yields and some changes in cropping patterns. This supplemental water supply would be much less certain than under the Proposed Action and the other alternatives and is too speculative to estimate impacts on production or prime farmland classifications.

3.9.6.10 Summary of Impacts

A summary of impacts for the Proposed Action and the MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives is shown in Table 3.9-8. Impacts under the Proposed Action and alternatives are the same except for the acreage temporarily and permanently disturbed.

3.9.6.11 Cumulative Impacts

Projects to be considered in the cumulative impact analysis are identified in Section 1.8. These projects identified would not affect agricultural resources in the impact area of influence; therefore, there would be no significant cumulative impact on agricultural resources.

Table 3.9-8
Summary of Significant Impacts for Agricultural Resources

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Resource	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action and MCAP Alternative				
Utah County				
Alfalfa	Increase of 38,246 tons/year	Significant	None	Significant
Barley	Decrease of 239,010 bushels/year	Significant	None	Significant
Corn grain	Increase of 75,676 bushels/year	Significant	None	Significant
Corn silage	Increase of 66,005 tons/year	Significant	None	Significant
Oat hay	Increase of 1,087 tons/year	Significant	None	Significant
Tart cherries	Increase of 5,660,000 lbs/year	Significant	None	Significant
Apples	Increase of 22,600,000 lbs/year	Significant	None	Significant
Prime agricultural land	Increase of 10,670 acres	Significant	None	Significant
Current agricultural land	A total of 422.4 acres of agricultural land would be temporarily impacted, and 38.6 acres permanently impacted by construction. Significant impacts to individual farms may occur.*	Significant	None	Significant
Juab County				
Alfalfa	Increase of 54,208 tons/year	Significant	None	Significant
Barley	Increase of 203,967 bushels/year	Significant	None	Significant
Corn grain	Increase of 1,710 bushels/year	Significant	None	Significant
Corn silage	Increase of 19,400 tons/year	Significant	None	Significant
Oat hay	Increase of 304 tons/year	Significant	None	Significant
Prime agricultural land	Increase of 15,338 acres	Significant	None	Significant
Current agricultural land	A total of 162.7 acres of agricultural land would be temporarily impacted, and zero acres permanently impacted by construction. Significant impacts to individual farms may occur.*	Significant	None	Significant
MCAPW-DFT and MCAPW Alternatives				
Utah County				
Alfalfa	Same as the Proposed Action			
Barley	Same as the Proposed Action			
Corn grain	Same as the Proposed Action			
Corn silage	Same as the Proposed Action			

Table 3.9-8
Summary of Significant Impacts for Agricultural Resources
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Resource	Impact	Significance	Mitigation	Significance After Mitigation
Oat hay	Same as the Proposed Action			
Tart cherries	Same as the Proposed Action			
Apples	Same as the Proposed Action			
Prime agricultural land	Same as the Proposed Action			
Current agricultural land	A total of 569.0 acres of agricultural land would be temporarily impacted, and 58.3 acres permanently impacted by construction. Significant impacts to individual farms may occur.*	Significant	None	Significant
Juab County - Same as Proposed Action				
MCATC Alternative				
Utah County				
Alfalfa	Same as the Proposed Action			
Barley	Same as the Proposed Action			
Corn grain	Same as the Proposed Action			
Corn silage	Same as the Proposed Action			
Oat hay	Same as the Proposed Action			
Tart cherries	Same as the Proposed Action			
Apples	Same as the Proposed Action			
Prime agricultural land	Same as the Proposed Action			
Current agricultural land	A total of 391.5 acres of agricultural land would be temporarily impacted, and 15 acres permanently impacted by construction. Significant impacts to individual farms may occur.*	Significant	None	Significant
Juab County - Same as Proposed Action				
MCAT Alternative				
Utah County				
Alfalfa	Same as the Proposed Action			
Barley	Same as the Proposed Action			
Corn grain	Same as the Proposed Action			
Corn silage	Same as the Proposed Action			
Oat hay	Same as the Proposed Action			

Table 3.9-8 Summary of Significant Impacts for Agricultural Resources Page 3 of 3				
Resource	**Impact**	**Significance**	**Mitigation**	**Significance After Mitigation**
Tart cherries	Same as the Proposed Action			
Apples	Same as the Proposed Action			
Prime agricultural land	Same as the Proposed Action			
Current agricultural land	A total of 63.7 acres of agricultural land would be temporarily impacted, and 1.1 acres permanently impacted by construction. Significant impacts to individual farms may occur.*	Significant	None	Significant
Juab County - Same as Proposed Action				
No Action Alternative				
Most of southern Utah and eastern Juab Counties would be unable to meet demands for full season water supplies. Shortages in supply would continue to worsen.		Significant	None	Significant
Southern Utah County agricultural lands	Slight increase in agricultural productivity	Not significant	None	Not significant
*These impacts include disturbance associated with the local distribution systems.				

3.10 Recreational Resources

3.10.1 Introduction

This section addresses impacts to recreational resources that could result from the construction, operation, and maintenance of SFN System facilities and related actions. The analysis focuses on potential temporary disruptions to recreational resources that would result from construction activities and permanent impacts that would result from system operation.

3.10.2 Issues Eliminated from Further Analysis

3.10.2.1 Provisions for Access to Mona Reservoir

The construction of the SFN System and related actions would not provide additional access to Mona Reservoir. An existing access road would provide access to the West Mona Pumping Plant, and no new access would be provided.

3.10.2.2 Water Level Stabilization in Utah Lake

Utah Lake water levels would be affected by the operation of the Bonneville Unit and not the operation of the SFN System alone. Potential impacts to Utah Lake recreational resources as a result of the operation of the Bonneville Unit are discussed in Chapter 2 of this DEIS.

3.10.2.3 Water Level Stabilization in Mona Reservoir

The SFN System would not stabilize Mona Reservoir surface water levels; therefore, this issue was not analyzed. Mona Reservoir surface level fluctuations under SFN System operation, however, would be modified (i.e., extreme highs and lows would be reduced). The resulting potential impacts to recreational resources are addressed in this section.

3.10.3 Issues Addressed in the Impact Analysis

The following issues are addressed in this impact analysis:

- Conversion of the High Line Canal right-of-way to a recreation trail
- Potential impacts of the SFN System on Burraston Ponds Wildlife Management Area
- Potential impacts of the SFN System on the recreational fisheries of Salt Creek Ditch
- Effect of the Proposed Action and its alternatives on recreation in Diamond Fork Canyon
- Enhancement of recreational fisheries in Sixth Water Creek, Diamond Fork Creek, and the upper and lower Spanish Fork River

3.10.4 Description of Impact Area of Influence

The impact area of influence for recreational resources is bounded by Hobble Creek and Utah Lake to the north, by Sixth Water and Diamond Fork Canyons to the east, by the San Pitch Mountains to the south, and by Currant and West Creeks to the west. Water resources that provide recreational opportunities within this area include Sixth Water Creek, Diamond Fork Creek, the Spanish Fork River, Peteetneet Creek, Beer Creek, Summit Creek, Salt Creek, Currant Creek, West Creek, Burraston Ponds, and Mona Reservoir.

3.10.5 Affected Environment

This section identifies and describes the recreational resources potentially affected by the construction and operation of the SFN System and the distribution, M&I, and on-farm systems. Recreational resources include both designated recreational areas and local recreational resources such as wildlife areas, local golf courses, multipurpose trails, regional and local parks, schools with public recreation facilities, and water resources within the impact area of influence. The affected environment described below applies to the Proposed Action and each of the alternatives; however, the affected environment for the No Action Alternative is limited to Sixth Water Creek, Diamond Fork Creek, lower Cottonwood Creek, and the Spanish Fork River.

Recreational resources that occur near the proposed locations of SFN System alternatives and distribution and on-farm system facilities and those resources that could be affected by changes in streamflows are identified in Table 3.10-1.

Table 3.10-1
Potentially Affected Recreational Resources Within the Impact Area of Influence

Resource	Description of Recreational Uses	Location of Predominant Recreational Uses	Period of Impact (Construction or Operation)
Diamond Fork Creek	Fishing	Diamond Fork Creek	Construction/ Operation
Diamond Fork Canyon	Picnicking, hiking, camping, cycling	Canyon bottom upstream of Monks Hollow	Construction/ Operation
Sixth Water Creek	Fishing	Strawberry Tunnel to Sixth Water Aqueduct	Operation
Spanish Fork River	Fishing	Upper and lower reaches of the Spanish Fork River	Construction/ Operation
Peteetneet Creek	Fishing	Peteetneet Creek south of Payson	Construction
Beer Creek	Fishing	Beer Creek (including Benjamin Slough)	Operation
Summit Creek	Fishing	Summit Creek south of Santaquin	Construction
Currant Creek	Fishing	Upper and lower Currant Creek	Operation
Mona Reservoir	Hunting, fishing	Mona Reservoir	Operation
Burraston Ponds	Fishing, picnicking, camping, sightseeing	Burraston Ponds	Operation
West Creek	Fishing, hunting	West Creek west and north of Nephi	Operation
Salt Creek	Fishing, swimming, wading	East of and within Nephi	Construction/ Operation
Municipal Golf Courses	Golfing	Nephi, Payson, Spanish Fork	Construction
General Activities	Sightseeing, hiking, birdwatching, hunting, etc.	Canyons and areas with water surface features throughout the area	Construction/ Operation

For purposes of this DEIS, the evaluation of the effects on recreational opportunities focuses on trout fishing, which would be affected by the Proposed Action and each of the alternatives. The fishing activity supported by a given waterway is expressed as angler-days, with an angler-day being 2.6 hours of fishing within a 24-hour period (Wiley and Thompson 1997b).

The determination of angler-use rates for streams supporting trout fisheries within the impact area of influence was based on the relationship of angler-days to trout standing crop in the Provo River. The 6-mile section of Provo River above the mouth of Provo Canyon supports a high quality wild trout fishery that is fished year-round and receives heavy usage (an estimated 65,000 angler-days per year [AD/YR] adjusted to the year 2000). The Utah Division of Wildlife Resources has both wild trout standing crop and angler-use information for the Provo River. Because the wild trout waters in the impact area of influence are about a 30-minute drive from the Provo River, it is assumed that the creation of a quality wild trout fishery in these waters will result in angler use similar to that of the Provo River.

The Utah Division of Wildlife Resources estimated that the Provo River receives 2.81 angler-days of use per pound of wild trout standing crop (Wiley and Thompson 1997b). Based on 557 pounds per acre of trout standing crop in the Provo River, the estimate also reflects that the Provo River is accessible for fishing year-round. Applications of this angler-use relationship to trout standing crop on other streams require adjusting the 2.8 angler-day use rate to the months that the stream is accessible to fishing. Should the stream be accessible only 8 months of the year, the angler-use calculation would use 67 percent of 2.81 angler-days (i.e., 1.9 angler-days per pound of trout) multiplied by the local trout standing crop.

3.10.5.1 Sixth Water Creek

Since 1915, Sixth Water Creek received the transbasin diversion from Strawberry Reservoir via the Strawberry Tunnel. Irrigation season flows exceeding 300 cfs scoured this 9.5-mile reach of stream that would normally carry natural flows in the range of 2 cfs to 30 cfs. Both the trout population and fishing accessibility have greatly declined as a result of these irrigation flows. Since June 1996, these irrigation flows have been released through Syar Tunnel and Sixth Water Aqueduct, entering Sixth Water Creek 3.6 miles upstream of Diamond Fork Creek. The 5.9 miles of Sixth Water Creek above the Syar Tunnel now carries natural flows augmented by about 5 cfs of seepage from Strawberry Tunnel. The trout population in this upper reach has begun to recover, and during 6 months of the year, the reach is accessible (i.e., flows are suitable for angling and physical access to the stream is not obstructed by snow). Lower Sixth Water Creek continues to convey irrigation flows that limit its trout population and accessibility to anglers. Upper Sixth Water Creek is capable of supporting 4,692 AD/YR under baseline conditions. The lower reach is accessible only 2 months of the year and supports 332 AD/YR.

CUPCA requires that when the Diamond Fork System is complete, sufficient water be released from Strawberry Tunnel to maintain minimum flows of 25 and 32 cfs (winter and summer) in Sixth Water Creek between the outlet of Strawberry Tunnel and Sixth Water Aqueduct. CUPCA also authorized the rehabilitation of the fish habitat in the creek between those two points, consistent with the minimum flows cited. The Mitigation Commission is planning a program of creek rehabilitation.

3.10.5.2 Cottonwood Creek

Entering Diamond Fork Creek at Three Forks, Cottonwood Creek is a relatively small creek that has less than 1 cfs of flow during dry years. The lowermost 0.1 mile of this creek is within the impact area of influence. Assuming that this creek is accessible 8 months of the year, angler-use in this reach is estimated at 15 AD/YR.

3.10.5.3 Diamond Fork Canyon

Diamond Fork Canyon, which includes Diamond Fork Creek and numerous tributary creeks and side canyons, provides the public with a variety of recreational opportunities including picnicking, camping, fishing, hiking, "mountain biking," and general enjoyment of nature. The Spanish Fork Ranger District of the Uinta National Forest estimates the Diamond Fork Creek watershed annually receives 600,000 recreation visitor days (1 recreation visitor day equals 12 hours) (Sensibaugh 1997).

3.10.5.4 Diamond Fork Creek

Above the confluence with Sixth Water Creek (Three Forks), Diamond Fork Creek has natural flows that include the inflow of both hot and cold springs in the 2.3 miles within the SFN System impact area of influence. Angler-use in this reach is calculated at 744 AD/YR, assuming 8 months of accessibility each year.

Below Three Forks, Diamond Fork Creek has received unnaturally high irrigation flows via Sixth Water Creek since 1915. These sustained high flows have eroded, widened, and degraded fish habitat in the 9.5 miles of Diamond Fork Creek between Three Forks and the Spanish Fork River. In addition to lowering the trout standing crop, the high flows limit fishing access to a 2-month period from mid-October through November when flows drop to base level and snow does not restrict vehicle access. This reach of Diamond Fork Creek supports 1,402 AD/YR.

3.10.5.5 Spanish Fork River

3.10.5.5.1 Upper Spanish Fork River. The primary recreational opportunity along the upper Spanish Fork River is sport fishing for brown trout and the occasional cutthroat trout hybrid. No creel census data were available for this portion of the river, but the Utah Division of Wildlife Resources describes angling pressure on the river as "light." One thousand fish per year are stocked on the Spanish Fork River between Thistle and the Strawberry Diversion Dam. The Utah Division of Wildlife Resources estimates that approximately 500 of these fish are available for anglers between the Diamond Fork confluence and the Strawberry Diversion Dam (Sakaguchi 1995). Using an assumption of angling accessibility 6 months of the year, the estimated angler-use on the upper Spanish Fork River is 285 AD/YR.

3.10.5.5.2 Lower Spanish Fork River. Because of seasonal flow limitations, sport fishing opportunities on the Spanish Fork River below the Strawberry Diversion Dam are limited. Fishable numbers and desirable sizes of wild brown and cutthroat trout may exist in the 2.8-mile stream reach between the East Bench Diversion and the Mill Race Canal Diversion. Estimated angler-use for this reach is 32 AD/YR based on accessibility for 8 months of the year.

3.10.5.6 Peteetneet Creek

In its upstream reaches (i.e., above the Maple Dell diversion), Peteetneet Creek contains both a wild brown trout population and a combined wild and stocked rainbow trout population (Sakaguchi 1994). However, the reach within the impact area of influence lacks perennial flows, has no fishery, and supports no angling recreation.

3.10.5.7 Beer Creek

While Beer Creek has a limited ability to support game fish species, Benjamin Slough (the lower segment of Beer Creek) experiences moderate angler-use during the spring for walleye and white bass. No creel census data were available for Beer Creek as it is not managed as a trout fishery by the Utah Division of Wildlife Resources (Sakaguchi 1995).

3.10.5.8 Summit Creek

A diversion dam on Summit Creek above Santaquin leaves the creek dry during some months. This lack of year-round surface water eliminates the creek's ability to support game fish in this section.

3.10.5.9 Currant Creek

Rainbow trout from Burraston Ponds occasionally move into the middle section of upper Currant Creek. As noted in Section 3.6, the Utah Division of Wildlife Resources typically stocks 500 catchable-size rainbow trout in lower Currant Creek immediately below Mona Dam. No angler-use data were available.

3.10.5.10 Mona Reservoir

Mona Reservoir is surrounded by private land and has no recreational facilities. However, the reservoir has been used for boating and fishing by the public. Access provided by a gravel-surfaced Juab County road from Goshen Canyon Road to the northwest corner of the reservoir near Mona Reservoir Dam. Juab County has proposed the development of a recreational day-use area at that location and the acquisition of the private land involved. Since 1992, Mona Reservoir has supported a fishery for yellow perch and a white/striped bass hybrid. However, the fishery potential in Mona Reservoir is limited by the lack of a minimum pool requirement (Sakaguchi 1995). No angler-use data were available for Mona Reservoir.

3.10.5.11 Burraston Ponds

Burraston Ponds is under private ownership, but is operated by the Utah Division of Wildlife Resources. The area is comprised of three ponds that are open to the public for fishing, picnicking, and general day-use. While no overnight campsites have been developed at Burraston Ponds, the Utah Division of Wildlife Resources allows overnight camping, and during summer months, the area is often filled to capacity. Sport fishing is the most popular recreational activity at Burraston Ponds, and the ponds currently support a rainbow trout fishery supported by the annual stocking of 18,000 catchable-size trout. Estimated angler-use at Burraston Ponds is 10,500 AD/YR (Sakaguchi 1998).

3.10.5.12 Salt Creek

Prior to the development of irrigated agriculture in the Nephi area, Salt Creek flowed west from the mouth of Salt Creek Canyon to West Creek. However, at present, Salt Creek ends at the diversion structure east of I-15 where the entire flow of Salt Creek (except for flood flow) is diverted into Salt Creek Ditch, which runs through Nephi. The original Salt Creek channel below the diversion structure has been converted to a flood control channel through Nephi and drains into Big Hollow at the west side of town. This flood control channel through Nephi is dry except when it carries flood flows that are bypassed at the diversion dam.

Salt Creek Ditch begins at the Salt Creek diversion structure east of Nephi and runs through Nephi to the railroad tracks on the west side of the community. The approximately 1.5-mile long ditch has a naturalized, unlined channel that is integrated with a community park and residential landscaping. When the flow is insufficient for irrigation west of Nephi, water is pumped into Salt Creek Ditch by adjacent irrigation wells that are owned and operated by the Nephi Irrigation Company. The ditch supports a wild brown trout fishery that is utilized by community residents.

At the railroad tracks, the entire flow of Salt Creek Ditch is diverted into unlined irrigation canals that run north and south along the tracks. It is estimated that the trout fishery of this irrigation canal extends 800 feet north and south from the end of the Salt Creek Ditch. Based on the wild trout standing crop, Salt Creek Ditch and the

adjacent sections of the north and south irrigation canals support an estimated 314 AD/YR, primarily fished by local residents.

3.10.5.13 Municipal Facilities

There are three golf courses near the proposed location of SFN System facilities: the Spanish Oaks, Gladstand, and Canyon Hills Park Golf Courses near the towns of Spanish Fork, Payson, and Nephi, respectively. Both Spanish Oaks Golf Course and Gladstand Golf Course are 18-hole golf courses and Canyon Hills Park Golf Course is a 9-hole course. Estimated daily use at each course ranges between approximately 100 and 200 golfers per day. All of the courses are open year-round, as weather permits. No other municipal recreational facilities are located near the SFN System facilities.

3.10.5.14 General Activities

Southern Utah and eastern Juab Counties have abundant opportunities for recreation such as sightseeing, hiking, birdwatching, and hunting. These activities occur throughout the impact area of influence.

3.10.6 Impact Analysis

This section presents an evaluation of the potential impacts to recreational resources that could result from the construction and operation of the Proposed Action and alternatives.

3.10.6.1 Significance Criteria

Impacts to recreational resources would be considered significant if the following occurred as a result of the Proposed Action or alternatives:

- Long-term reduction of recreational opportunities at existing recreation use areas or reduction of public accessibility to existing recreation use areas (e.g., gate installation, reduced or prohibited access to ramps or access roads, new or increased user fees). Short-term interruptions resulting from construction activities would not be considered significant.

- Enhancement of recreational opportunities by improving access to existing recreation use areas, improving existing recreation use areas, or providing new recreation use areas.

- Change in the type of recreational opportunity in a recreation use area (e.g., access is changed from a trail to a road, restoration of fisheries would add sport fishing to an area where these opportunities are presently limited or would increase angler-use).

These criteria are based on State and local recreation plans, recommended standards, and professional judgement.

3.10.6.2 Impacts Eliminated from Further Analysis

3.10.6.2.1 Operation Impacts to Recreational Activities on Summit and Peteetneet Creeks. There would be no impacts to recreational activities in these waterways as a result of the operation of SFN System facilities.

3.10.6.2.2 Operation Impacts to Recreational Activities at Beer Creek, West Creek, Mona Reservoir, Currant Creek, and Burraston Ponds. Fishing is the main recreational activity on Beer Creek, West Creek, Mona Reservoir, Currant Creek, and Burraston Ponds. According to the analysis presented in Section 3.6.6.3.2,

there would be no significant impact to sport fish resources; therefore, there would be no significant impact on recreational opportunities.

3.10.6.3 Proposed Action

The following sections describe construction- and operation-related impacts that would result from the Proposed Action. These impacts are summarized in Section 3.10.6.10. In general, the construction and operation of the Proposed Action would not interfere with activities such as sightseeing, hiking, bird-watching, and hunting. Specific impacts related to visual and wildlife resources that may detract from these activities are discussed in Section 3.14, Visual Resources, and Section 3.5, Wildlife Resources. Construction activities in the Diamond Fork drainage would place some restrictions on access to the area. These restrictions would be short-term and not significant.

3.10.6.3.1 Construction Impacts. Impacts to recreational resources during construction of the "Diamond Fork Tunnel Alternative" would be temporary and are not considered significant for the purposes of this analysis (see significance criteria above). Main Conveyance Aqueduct crossings would be constructed in accordance with the description of construction activities in Chapter 1, and sport fisheries in Peteetneet and Summit Creeks would not be adversely impacted.

Use of Spanish Oaks and Gladstand Golf Courses would not be affected during the construction or operation of the Proposed Action. Located east of Nephi and north of Salt Creek, the Canyon Hills Golf Course would be adjacent to and crossed by approximately 0.25 mile of the Salt Creek Pipeline. It is not anticipated that the construction of the pipeline would preclude use of the golf course at any time. However, construction areas would have to be avoided by golfers and golf course personnel. This impact would be short-term and would not be significant.

Construction of the Salt Creek pumping facility at the lower end of the Salt Creek Ditch would displace 0.01 acre of riverine habitat currently supporting a trout fishery, which would create a loss of 1.5 angler-days per year. This would not be a significant impact.

3.10.6.3.2 Operation Impacts. Under the Proposed Action, angler-use of Sixth Water Creek, Diamond Fork Creek, the Spanish Fork River, and Salt Creek Ditch would total 39,351 AD/YR. This would be a 403 percent increase over the baseline conditions of 7,816 AD/YR and a significant beneficial impact. Descriptions of this increase by stream are presented in the following sections.

3.10.6.3.2.1 Sixth Water Creek. Sport fishing in upper Sixth Water Creek would benefit from the CUPCA-mandated minimum flow releases through the Strawberry Tunnel. Angler use in this reach would increase from 4,692 AD/YR to 8,911 AD/YR, an increase of 90 percent over baseline conditions. Sixth Water Creek below the Tanner Ridge Tunnel inlet (i.e., lower Sixth Water Creek) would be substantially improved as a fishery. This improvement would result from irrigation flows from Strawberry Reservoir released to Tanner Ridge Tunnel rather than Sixth Water Creek. Below the Tanner Ridge Tunnel inlet, the average monthly summer flow under the Proposed Action would not exceed 51 cfs. The removal of Strawberry Reservoir irrigation releases to Sixth Water Creek would increase angler use from 332 AD/YR to 4,702 AD/YR, a 1,316 percent increase over baseline.

3.10.6.3.2.2 Diamond Fork Creek Above Three Forks. The Proposed Action would not change the flow regime in Diamond Fork Creek above Three Forks from baseline conditions. Angler-use of this 2.3-mile reach would be temporarily diminished during construction of the Proposed Action, but would otherwise be unchanged from the baseline conditions of 744 AD/YR.

3.10.6.3.2.3 Diamond Fork Creek Below Three Forks. Under the Proposed Action, Diamond Fork Creek between Three Forks and the Spanish Fork River would have a base flow limited to 60 cfs below Monks Hollow.

Angler-use on Diamond Fork Creek would increase from 1,402 AD/YR to 21,877 AD/YR. This 1,460 percent increase over baseline would result from increased numbers of wild trout in response to the lower, more stabilized flow regime, as described in Section 3.6.6.3.2. The Utah Division of Wildlife Resources would manage this as a wild trout fishery, but would not stock catchable-size hatchery trout, except possibly in the immediate vicinity of the USFS campgrounds. This large increase in numbers of wild trout would be a beneficial impact to recreational resources on Diamond Fork Creek.

3.10.6.3.2.4 Diamond Fork Canyon. Excluding enhanced fisheries, there would be no change under the Proposed Action in the trail system or other general recreational opportunities in Diamond Fork Canyon from present conditions.

3.10.6.3.2.5 Upper Spanish Fork River. It is estimated that angler-use on the upper Spanish Fork River would increase from 285 to 1,760 AD/YR as a result of the Proposed Action. This 518 percent increase over baseline would result from an improvement in fisheries habitat as described in Section 3.6.6.3.2. This would be a beneficial impact to recreational resources on the upper Spanish Fork River.

3.10.6.3.2.6 Lower Spanish Fork River. It is estimated that angler-use on the lower Spanish Fork River would increase from 32 AD/YR to 1,050 AD/YR as a result of the Proposed Action. This 3,181 percent increase over baseline in angler-use would result from year-round flows (as described in Section 3.6.6.3.2). This would be a beneficial impact to recreational resources on the lower Spanish Fork River.

3.10.6.3.2.7 Salt Creek Ditch. Under the Proposed Action, failure to supply year-round flow to the irrigation canal on the west side of Nephi would result in a loss of 22 angler-days per year (a 7 percent decrease) and a significant impact to recreational resources.

3.10.6.3.2.8 Proposed Recreation Trail. A recreation trail would be constructed along part of the Main Conveyance Aqueduct in southern Utah County (see Section 1.6.2.7.1). The trail would be accessible to pedestrians, cyclists, equestrians, and Nordic skiers. It is anticipated that the recreation trail would be incorporated as a segment of the planned and partially constructed Bonneville Shoreline Trail. Estimated use of the trail is 35,000 user-days per year (Einert 1995), with one user-day being equivalent to 2 hours of use by one person. It is likely that approximately 75 percent of recreation trail use would occur in the summer months. The recreation trail would have a significant beneficial impact on recreational resources in the area by providing a safe and accessible recreational opportunity for a variety of recreational activities.

3.10.6.3.3 Mitigation. None.

3.10.6.3.4 Unavoidable Adverse Impacts. The 7 percent reduction in fishing opportunities associated with the Salt Creek Ditch irrigation canals on the west side of Nephi would be an unavoidable adverse impact.

3.10.6.4 MCAPW-DFT Alternative

Impacts on recreational resources resulting from the construction and operation of the MCAPW-DFT Alternative would be similar to those described for the Proposed Action except that the recreation trail would not be built. Because of the higher flows in the Spanish Fork River, angler-use would increase over baseline conditions, but not as much as would occur with the Proposed Action. Total annual angler-days for the MCAPW-DFT Alternative in area streams would be 38,511, slightly less than the 38,592 angler-days associated with the Proposed Action. The angler-use associated with the MCAPW-DFT Alternative, however, would be 446 percent greater than baseline angler-use, which would be a significant beneficial impact to recreational resources. The unavoidable adverse impact would be the same as that described for the Proposed Action.

3.10.6.5 MCAP Alternative

3.10.6.5.1 Construction Impacts. Impacts to recreational resources that would result from constructing the MCAP Alternative would be same as those described for the Proposed Action except for the loss of riverine fisheries habitat to the imprint of Monks Hollow Dam and Reservoir. Inundation of portions of lower Sixth Water Creek, Cottonwood Creek, and Diamond Fork Creek would eliminate 349 angler-days that presently occur under baseline conditions.

3.10.6.5.2 Operation Impacts. The same beneficial impacts would result from the recreation trail as described under the Proposed Action. Monks Hollow Reservoir would create a 33,100 acre-foot flatwater fishery. This reservoir would have a 110-foot seasonal drawdown that would limit productivity to an estimated standing crop of about 4,075 pounds of seasonally stocked trout (USBR 1991). Angling access to the reservoir would be somewhat limited because of the steep and rugged shoreline. Angler-use of the reservoir fishery would be 2,628 AD/YR (USBR 1991).

Under the MCAP Alternative, angler-use of Sixth Water Creek, Cottonwood Creek, Diamond Fork Creek, the Spanish Fork River, and Salt Creek Ditch would total 31,536 AD/YR, a 303 percent increase in angler-use over baseline conditions and a significant impact. Descriptions of this increase by stream are presented in the following sections.

3.10.6.5.2.1 Sixth Water Creek. Lower Sixth Water Creek would receive substantially higher irrigation flows, but angling use would increase from 332 AD/YR to 581 AD/YR. This increase of 75 percent over baseline conditions would be a significant beneficial impact.

3.10.6.5.2.2 Diamond Fork Creek. The effects of the MCAP Alternative on recreational opportunities on Diamond Fork Creek downstream from Monks Hollow would be the same as those described for the Proposed Action. Above Monks Hollow, the loss of riverine angler-use would be the same as described in Section 3.10.6.5.1.

3.10.6.5.2.3 Spanish Fork River. Impacts to the Spanish Fork River would be the same under the MCAP Alternative as those described for the Proposed Action.

3.10.6.5.2.4 Diamond Fork Canyon. Monks Hollow Reservoir would inundate portions of the existing trail system and impact other general recreational opportunities in Diamond Fork Canyon. While the existing trail system and general recreational opportunities would be affected, flatwater-based recreational opportunities centered around the proposed day-use area on Monks Hollow Reservoir would be provided. The completion plan for the Diamond Fork System contains various recreational facilities that were presented in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) and reiterated in the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). These facilities would include a trail around the south side of Monks Hollow Reservoir that would provide access to the trails along Sixth Water, Fifth Water, and Cottonwood Creeks. Access to those trails is currently provided by a roadside trailhead at Three Forks, which would be inundated by Monks Hollow Reservoir. A recreation area with day-use facilities on the north side of Monks Hollow Reservoir would also be included. Monks Hollow Dam and Reservoir would create a significant beneficial recreational impact (USBR 1984).

3.10.6.5.3 Unavoidable Adverse Impacts. In addition to the loss of 22 angler-days at Salt Creek Ditch, the MCAP Alternative would eliminate 349 AD/YR on riverine habitat that would be lost to inundation.

3.10.6.6 MCAPW Alternative

Impacts on recreational resources resulting from the construction and operation of the MCAPW Alternative would be similar to those described for the MCAP Alternative except that the recreation trail would not be built. Because of the higher Spanish Fork River flows, total annual angler-days would be 31,292, slightly less than the 31,536 angler-days associated with the MCAP Alternative. Angler-use associated with the MCAPW Alternative would be 300 percent greater than baseline and would be a significant impact to recreational resources. Unavoidable adverse impacts would be the same as those described for the MCAP Alternative.

3.10.6.7 MCATC Alternative

Impacts associated with the MCATC Alternative would be similar to those identified for the MCAP Alternative, except that the recreation trail would not be constructed; therefore, the projected increase in recreational use would not occur. Under the MCATC Alternative, total angler-use would be 31,536 AD/YR, or 300 percent greater than baseline. Unavoidable adverse impacts would be the same as those described for the MCAP Alternative.

3.10.6.8 MCAT Alternative

Impacts to recreational resources that would result from the construction and operation of the MCAT Alternative would be similar to those described for the MCAPW Alternative. Because of the higher Spanish Fork River flows, angler-use would increase over baseline conditions, but would be less than those that would occur under the Proposed Action. Total annual angler-days with the MCAT Alternative for area streams would be 31,292, 20 percent less than the 39,351 angler-days associated with the Proposed Action. The angler-use associated with the MCAT Alternative would be 300 percent greater than the baseline conditions and would be a significant impact. Unavoidable adverse impacts would be the same as those described for the MCAP Alternative.

3.10.6.9 No Action Alternative

3.10.6.9.1 Construction Impacts. Impacts on recreational resources that would result from constructing the No Action Alternative include the loss of riverine fishery habitat to the imprint of Three Forks Dam and Reservoir. Inundation of portions of lower Sixth Water Creek, Cottonwood Creek, and Diamond Fork Creek would eliminate 153 AD/YR that presently occur under baseline conditions.

3.10.6.9.2 Operation Impacts. The construction of Three Forks Dam and Reservoir would create a small impoundment of approximately 14 acre-feet that would fluctuate about 27 feet on a daily basis to about an 8 acre-foot minimum pool (USBR 1990). This impoundment would provide negligible flatwater fish habitat and angler-use.

Angler-use impacts would be same as those described for the Proposed Action for upper Sixth Water Creek and Diamond Fork Creek below Monks Hollow. Angler-days for Diamond Fork Creek between Three Forks and Monks Hollow would be slightly less than would occur under the Proposed Action. Including the riverine habitat lost to inundation, lower Sixth Water Creek angler-use would be 495 AD/YR, a 49 percent increase over baseline conditions; upper Spanish Fork River angler-use would be 73 AD/YR, a 74 percent reduction from baseline conditions. For both of these streams, the change would largely occur because high flows would reduce angler accessibility to 1 month of the year. Lower Spanish Fork River angling use would remain the same as under baseline conditions.

Total annual angler-days would be 31,513 with the No Action Alternative compared to 7,816 angler-days associated with baseline conditions, resulting in a 303 percent increase over baseline conditions and a significant impact.

3.10.6.9.3 Mitigation. None.

3.10.6.9.4 Unavoidable Adverse Impacts. Three Forks Dam and Reservoir would inundate riverine trout habitat presently supporting 153 AD/YR. Upper Spanish Fork River angler-use would be reduced by 74 percent because of high flows during 11 months of the year.

3.10.6.10 Summary of Impacts

A summary of impacts for the Proposed Action and each of the alternatives is presented in Table 3.10-2.

Table 3.10-2
Summary of Impacts for Recreational Resources

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Resource	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Sixth Water Creek sport fishing	Angler-use would increase by 4,219 AD/YR in the upper reach and increase by 4,370 AD/YR in the lower reach.	Significant	None	Significant
Diamond Fork Creek sport fishing	Angler-use would increase by 20,475 AD/YR; the reach would be managed as a wild trout fishery.	Significant	None	Significant
Upper Spanish Fork River sport fishing	Angler-use would increase by 1,475 AD/YR.	Significant	None	Significant
Lower Spanish Fork River sport fishing	Angler-use would increase by 1,018 AD/YR.	Significant	None	Significant
Recreation Trail	Estimated 35,000 user-days per year.	Significant	None	Significant
Salt Creek Ditch and canal sport fishing	Reduction of 22 AD/YR on the canal system in Nephi.	Significant	None	Significant
MCAPW-DFT Alternative				
Same as the Proposed Action except that angler-days per year would be 243 less on the upper Spanish Fork River and 163 greater on the lower Spanish Fork River.				
MCAP and MCATC Alternative				
Monks Hollow Reservoir	Creation of 2,628 AD/YR of reservoir fishing.	Significant	None	Significant
Riverine habitat	Loss of portions of lower Sixth Water, Cottonwood, and Diamond Fork Creeks to inundation by Monks Hollow Reservoir would eliminate 349 AD/YR.	Significant	None	Significant
Sixth Water Creek sport fishing	Upper Sixth Water Creek angler-use would be the same as under the Proposed Action. In the lower reach, angler-use would be 4,121 AD/YR less than under the Proposed Action (excluding loss to inundation).	Significant	None	Significant

Table 3.10-2
Summary of Impacts for Recreational Resources
Page 2 of 2

Resource	Impact	Significance	Mitigation	Significance After Mitigation
Diamond Fork Creek, Spanish Fork River, and Salt Creek Ditch sport fishing	Same as Proposed Action.	Significant	None	Significant
Recreation Trail (MCAP Alternative only)	Estimated 35,000 user-days per year.	Significant	None	Significant
MCAPW and MCAT Alternatives				
Same as the MCAP Alternative except that there would be 243 fewer AD/YR on the upper Spanish Fork River.				
No Action Alternative				
Riverine habitat	Inundation of portions of lower Sixth Water, Cottonwood, and Diamond Fork Creeks by Three Forks Reservoir would eliminate 153 AD/YR.	Significant	None	Significant
Sixth Water Creek sport fishing	Upper Sixth Water Creek angler use would be the same as under the Proposed Action. In the lower reach, angler use would be 4,027 AD/YR less than under the Proposed Action (excluding loss to inundation).	Significant	None	Significant
Salt Creek Ditch and canal sport fishing	Reduction of 22 AD/YR from baseline.	Significant	None	Significant
Note: This summary includes both construction- and operation-related impacts.				

3.10.6.11 Cumulative Impacts

The development of a recreation trail under the Proposed Action and the MCAP Alternative would have a beneficial cumulative impact with plans for the Bonneville Shoreline Trail and the non-motorized transportation planning goals of the Mountainland Association of Governments. Development of the recreation trail would enhance the trail network in southern Utah County and would add a significant segment to the Bonneville Shoreline Trail. No other cumulative impacts to recreational resources were identified.

3.11 Public Health & Safety/Noise

3.11.1 Introduction

This section addresses potential impacts on human health and safety that could occur as a result of construction and operation of the SFN System and related actions. The analysis focuses on four topics: public exposure to toxics and pollutants during construction; the risk of pipeline rupture by system failure or seismic activity; increased potential for injuries resulting from public access to project facilities; and public exposure to increased noise levels during construction and operation of the SFN System.

3.11.2 Issues Eliminated from Further Analysis

No issues have been eliminated from further analysis.

3.11.3 Issues Addressed in the Impact Analysis

The following issues were identified during the scoping process and are addressed in the impact analysis:

- Public exposure to toxics and pollutants as a result of:
    - Increased public exposure to agricultural chemicals as a consequence of increased agricultural land productivity
    - Increased exposure to air pollutants, such as mobile source fugitive emissions, and exposure to asbestos, silica, and other soil contaminants
    - Decline of water quality in violation of State water quality standards for recreation (secondary contact) and agricultural foods
- Pipeline rupture
    - Possible pipeline rupture as a consequence of seismic activity or system failure resulting from SFN System flow capacities or from damage to the SFN System caused by ongoing mining activities in the vicinity of the SFN System's proposed tunnels
- Public access
    - Injuries as a consequence of public access to SFN System features and facilities during or following construction
    - Drowning as a consequence of increased water flow volumes in rivers and streams within the impact area of influence
    - Increased potential for traffic accidents within the impact area of influence as a consequence of construction, transportation of project materials, or SFN System operations
    - Delays in emergency vehicle response time during construction

- Noise levels
  - Public exposure to noise levels that exceed allowable noise standards for public health

3.11.4 Description of Impact Area of Influence

The impact area of influence for public heath and safety and noise includes population centers and public facilities within southern Utah and eastern Juab Counties located in proximity to the SFN System. The impact area of influence for public access also includes the primary watercourses that would be affected by operation of the SFN System; in particular, Diamond Fork Creek, the Spanish Fork River, and Salt Creek.

3.11.5 Affected Environment

The affected environment relative to public health and safety and noise includes areas where human health and safety and the public's noise environment could be adversely affected by construction or operation of the SFN System and related actions.

For the purposes of considering public health and safety and noise resources, the affected environment includes the Diamond Fork drainage and areas near the proposed Main Conveyance Aqueduct alignment in southern Utah and eastern Juab Counties. The affected environment also includes transportation corridors that would be used by construction and CUWCD personnel to access SFN System features, as well as areas surrounding SFN System features.

3.11.5.1 Residential Areas

Several population centers are located within the impact area of influence. These include the cities of Salem, Payson, Santaquin, Mona, and Nephi and the community of Woodland Hills. Within the impact area of influence, southern Utah County has the greatest population concentration. Residences and businesses are located throughout the area, and a few homes are also located near the mouth of Pole Canyon in Spanish Fork Canyon. A number of rural homes are also located between Salem and Santaquin. In eastern Juab County, there are a few scattered rural residences, with homes located primarily in and around Mona and Nephi.

Within these residential areas and throughout agricultural areas in southern Utah and eastern Juab Counties, a vast network of open irrigation canals exists. As with any open water source, these canals present a drowning hazard to area residents. Additionally, some canals located along roadsides reduce or eliminate road shoulders, creating transportation safety hazards as well.

3.11.5.2 Transportation Networks

Two major highways (I-15 and Highway 6) and three railroads (Denver and Rio Grande Western, Utah, and Union Pacific Railroads) are located within the impact area of influence. I-15 runs north-south through Utah and Juab Counties. Highway 6 and the Denver and Rio Grande Western Railroad run through Spanish Fork Canyon. The Union Pacific Railroad operates a rail line that passes through the west side of Nephi.

3.11.5.3 Water Quality

The existing water quality within the impact area of influence is discussed in detail in Section 3.3, Water Quality. Water quality parameters that could affect public health and safety include coliform, nitrate, and trace element levels. Currently, coliform standards are exceeded in Benjamin Slough, posing a minor health threat if individuals were to swim in Benjamin Slough; nitrate levels are occasionally exceeded at Spring Creek; zinc has been found

at elevated levels in fish within the impact area of influence; and selenium has been identified as elevated in both fish and invertebrate-eating aquatic birds in the area. These exceedences of standards and elevated trace element levels do not currently pose a significant threat to public health and safety.

3.11.5.4 Air Quality

The existing air quality within the impact area of influence is discussed in detail in Section 3.16, Air Quality. Air quality parameters that could affect public health and safety include the presence of increased levels of air emissions such as nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), particulate matter less than 10 microns in diameter (PM_{10}), and lead. Currently, Juab County is in attainment with all National Ambient Air Quality Standards (NAAQS) and Utah County is in attainment with all NAAQS with the possible exception of PM_{10} and CO (carbon monoxide level exceedences were limited to the cities of Orem and Provo, outside the impact area of influence). PM_{10} levels can fluctuate greatly depending on local influences. PM_{10} levels exceeding the NAAQS may cause breathing difficulties in susceptible persons (including infants, the elderly, and people with existing respiratory problems).

3.11.5.5 Noise Sources and Sensitive Receptors

The perception of sound is very subjective. Sound that one person would find enjoyable could be very annoying to another. Sound, when considered annoying or offensive, is referred to as noise. Sound levels are measured in decibels (dB). However, the human ear has a limited range of sensitivities to sound levels; thus, a scale better reflecting human hearing is used for that purpose. This "weighted" scale is called the "A-weighted" scale and is denoted as dBA. Noise ordinances use this scale, and it is used in this DEIS for the purpose of comparing existing levels of sound to projected sound levels resulting from SFN System construction and operation activities.

The existing noise environment within the impact area of influence is primarily a function of residential and commercial activities and the presence of dominant noise sources. The Diamond Fork drainage is a remote area with few noise sources and few sensitive receptors. However, people using the area are often seeking solitude and quiet; therefore, the introduction of increased sound (both in loudness and duration) could be an irritant. Within Spanish Fork Canyon, noise sources are limited to traffic noise along Highway 6 and periodic noise from passing trains. The noise levels experienced within the canyon are greatly influenced by topography since the steep canyon walls tend to intensify noise levels. Near the mouth of Spanish Fork Canyon, noise levels from the same sources are expected to be lower because of the wider topographic area. Noise levels within the canyon are also expected to vary by season, since heavy snowfall serves to muffle ambient noise. Sensitive receptors along the route of the Main Conveyance Aqueduct within Spanish Fork Canyon are motorists on Highway 6 and the two residences located near Pole Canyon.

Existing noise characteristics between Spanish Fork Canyon and the area south of Payson are similar to those found in moderately developed suburban areas. Sensitive noise receptors include area residents. From south of Payson to just north of Nephi, the noise environment is predominantly the result of agricultural activities, with additional noise resulting from traffic on I-15.

The city of Nephi is the only community within the impact area of influence that has an established noise ordinance. The ordinance applies to stationary sources, which must have noise levels within a 6 dBA one-hour equivalent sound level of established ground transportation noise measurements. If the sound has a pronounced audible tonal quality that is a whine or has other annoying qualities that are defined, 5 dBA is added to the measured sound level. If the sound is of a repetitive impulse nature, 10 dBA is applied to the measured level. The primary noise sources in Nephi are I-15 on the eastern edge of the city and the rail line running through the western part of the city. An average of 8 to 10 trains pass through Nephi each day.

The Utah Department of Transportation (UDOT) has a noise abatement policy. While the policy would not apply to the SFN System because it is not a UDOT project, some UDOT standards were used in this analysis since they provide useful information on noise sensitivity levels.

The noise environment within the agricultural areas of southern Utah and eastern Juab Counties is associated with farming operations, limited local traffic, noise from I-15, and the rail line identified near Nephi.

Table 3.11-1 lists common noise levels for various residential settings. For purposes of this analysis, an average background noise level of 57 dBA is assumed for the impact area of influence.

Table 3.11-1
Typical Noise Levels for Different Urban Settings

Description	Typical Loudness Range (dBA)	Average Loudness (dBA)
Quiet suburban residential	48-52	50
Normal suburban residential	53-57	55
Urban residential	58-62	60
Noisy urban residential	63-67	65
Very noisy urban residential	68-72	70

Source: Canter, L.W. 1977

3.11.6 Impact Analysis

3.11.6.1 Significance Criteria

Impacts to public health and safety and noise resulting from the construction, operation, and maintenance of the SFN System and distribution and on-farm systems were determined using the following criteria:

- **Public Exposure to Toxics and Pollutants.** Significant impacts would be found if federal or State ambient air quality standards were violated. Violations of water quality standards would be detrimental to public health and safety in two cases:
    - If State water quality standards (see Section 3.3, Water Quality, for these standards) for recreation (secondary contact) were exceeded where they were not exceeded before construction and operation of the SFN System.
    - If guidelines for trace elements in vegetation (including agricultural crops) and wildlife were exceeded where they were not exceeded before construction and operation of the SFN System. These exceedences could pose a threat to public safety if contaminated vegetation and/or wildlife were consumed.
- **Pipeline Rupture.** Pipe rupture or any other system component failure could result in flooding of residential, commercial, or agricultural properties; rupture or system failure could result in off-season flooding in key wildlife areas or areas of threatened and endangered species.

- **Public Access.** Significant impacts would be found if any of the following were to occur: the public could gain access to system features posing a potential threat to human health and safety; construction or operation could pose a potential threat to human health and safety; system construction could cause a disruption of more than 15 minutes to response times or access for emergency response vehicles or normal traffic patterns.

- **Noise Levels.** Significant impacts would be found if local, State, or federal noise level standards were violated.

3.11.6.2 Proposed Action

The following sections describe the construction- and operation-related impacts resulting from the Proposed Action. These impacts are summarized in Section 3.11.6.9.

3.11.6.2.1 Public Health and Safety

3.11.6.2.1.1 Water Quality. No significant impacts to public health and safety resulting from changes in water quality would be expected to occur from construction of the Proposed Action. Standard operating procedures, as described in Appendix B, *Standard Operating Procedures*, would be followed during construction, including proper storage of fuels and other construction materials that could adversely affect water bodies in the event of an accidental spill or release.

The water quality analysis in Section 3.3, Water Quality, indicates that operation of the SFN System under the Proposed Action would cause no measurable change to existing coliform levels in Benjamin Slough. Nitrate levels would not measurably change as a result of the Proposed Action; therefore, no significant impacts would occur. TDS levels would increase; however, this increase would have no significant impact on public health and safety as TDS are not harmful to humans in existing or projected quantities.

Small, long-term increases in trace elements would occur in surface waters receiving irrigation return flows. The Proposed Action could cause a small, long-term increase in average trace element concentrations to biota, fish, and aquatic birds. Levels would not exceed established guidelines and cause a threat to public health and safety resulting from human consumption; thus, no significant impacts would occur.

3.11.6.2.1.2 Air Quality. As discussed in Section 3.16, Air Quality, construction of the Proposed Action would require temporary activities that produce air pollution emissions. Residents close to heavy construction activities could be exposed to temporary violations of the federal 24-hour PM_{10} standard. However, implementation of the specific actions identified in Appendix B, *Standard Operating Procedures*, to minimize short-term construction dust would substantially reduce these impacts. As discussed, elevated PM_{10} could cause breathing difficulties in some sensitive receptors. Although impacts would be significant, they would be short-term and extremely localized.

3.11.6.2.1.3 Construction Hazards. Construction activities associated with the Proposed Action could pose hazards to the public in populated areas. However, all construction areas would be clearly marked as part of standard operating procedures, and any hazards would be removed at the end of each construction day. Trenches would not exceed 600 linear feet and would be backfilled or securely covered at the end of each day. Construction hazards would not pose a significant threat, or impact, to public health and safety.

3.11.6.2.1.4 Pipeline Rupture. The potential for rupture of a properly designed and constructed pipeline is extremely small. The only realistic cause of pipeline rupture would be a major earthquake or mining accident. The alignment of the Main Conveyance Aqueduct would cross the Wasatch Fault in the general vicinity of the mouth of Spanish Fork Canyon and parallel this fault to the vicinity of Nephi. The maximum credible earthquake

on this fault is magnitude 7.5 on the Richter scale, and fault segments studied along the Wasatch Front are estimated to have a return period of 500 to 2,600 years (USBR 1990). No active mines that could pose a danger of pipeline rupture are located in the vicinity of the pipeline.

Pipeline rupture could cause injuries or deaths from drowning, but the exact effects of pipeline failure are difficult to quantify. Similarly, predicting the most likely site for pipeline failure is also difficult. The vicinity of Turnout SU4, east of Payson, was selected for this impact analysis because it would be the point of greatest internal pressure on the pipeline. A pipeline rupture near Turnout SU4 could result in flows of up to 2,400 cfs, releasing a total of approximately 110 acre-feet of water if stop valves were not immediately closed. Water would flow downhill from the rupture, potentially flooding residences and commercial and public property near Payson.

The potential for rupture along the "Diamond Fork Tunnel Alternative" would be low. No particular area along the "Diamond Fork Tunnel Alternative" alignment would have a greater risk of rupture than areas along the Main Conveyance Aqueduct. If a rupture were to occur within these areas, the floodwaters would follow the normal course of Diamond Fork Creek or Sixth Water Creek. The narrow topography within the area would restrict the lateral spread of floodwater to near Red Hollow. From this point downstream, the floodwater would be more laterally spread along the wider canyon floor.

If the Main Conveyance Reservoir had a total embankment failure, flooding could occur in the northernmost part of the city of Mona. The capacity of the Main Conveyance Reservoir is 300 acre-feet. Water would flow along the path of least resistance toward and over I-15 or through nearby culverts and could then flow toward northern Mona and Pioneer Memorial Park. Flooding, as described above, could result in a loss of life or injury to people in the vicinity and would be a significant impact. The potential for dam rupture or failure, however, would be extremely low. Seismic studies would be conducted to determine the best design, and the dam would be constructed to withstand any expected seismic event in the area.

3.11.6.2.1.5 Blasting. It is possible that some blasting may be required during construction of the Proposed Action. Any blasting would follow established government standards and is not expected have a significant impact.

3.11.6.2.1.6 Emergency Services. Disruption to emergency vehicle services during construction could occur in communities with limited access. Both Woodland Hills and Elk Ridge are accessible by only two roads. As discussed in Section 3.15, Transportation, it is likely that approximately 1.0 mile of Highway 6 in Spanish Fork Canyon (at its narrowest point just south of Covered Bridge) would be closed to two-way traffic during construction activities, resulting in traffic delays of up to 30 minutes. Additionally, construction activities along Diamond Fork Road would require controlled vehicle access into the Diamond Fork drainage. However, emergency vehicles would have priority access through the construction zone coordinated via radio communication with the traffic flagmen. Therefore, no significant impact to emergency services would occur.

3.11.6.2.1.7 Recreation Trail. Safety issues related to the development of the proposed recreation trail would involve access to the trail at the Spanish Fork trailhead parking area. The Spanish Fork trailhead parking area would be accessed by turning off Highway 6 into the parking area, located approximately 100 yards west of a bend in the highway. Motorists turning this corner could have to rapidly reduce speeds to avoid vehicles pulling into or out of the parking area. This would pose a significant threat (impact) to public health and safety.

To access the Spanish Fork trailhead from the parking lot, trail users would have to cross two sets of railroad tracks. These tracks curve approximately 100 yards east of the crossing, causing poor visibility for trail users and creating a safety hazard that could result in collisions. This would pose a significant threat (impact) to public health and safety.

Other potential safety hazards would be located at any road and trail crossings and around the SWUA power plant and diversion dam. These hazards would be alleviated, as discussed in Section 1.6. For example, signs and other markers would be posted at trail crossings, and fencing and guard rails would be installed at the power plant to keep trail users away from hazards surrounding the diversion structure. Thus, no significant impacts would occur.

3.11.6.2.1.8 Public Access. Public access to project facilities, specifically open bodies of water such as reservoirs and regulating ponds, could pose a public hazard. Potential hazards would be fenced and locked, thus eliminating any potential safety threat (impact) to the public.

3.11.6.2.2 Noise

3.11.6.2.2.1 Construction Impacts. Table 3.11-2 indicates the noise levels for the three loudest construction activities at various distances.

Table 3.11-2
Predicted Noise Levels Associated with Construction Activities (dBA)

Distance (feet)	Construction Activity		
	Trench Excavation	Pipe Laying	Pipe Bedding and Backfill
50	90.5	90.8	92.1
100	84.5	84.8	86.1
200	78.5	78.8	80.1
400	72.5	72.8	74.1
800	66.5	66.8	68.1
1,600	60.5	60.8	62.1

The UDOT Noise Abatement Policy lists various levels of noise sensitivity. For most residential and city areas, the exterior threshold of sensitivity is 67 dBA hourly weighted. Thus, residential dwellings within 767 feet for trench excavation, within 786 feet of the pipe laying operations, and within 946 feet of pipe bedding operations and backfilling would be exposed to levels at 67 dBA or greater. Noise impacts in these areas would be short-term, significant, and unavoidable. The greatest impacts would be to houses along the pipeline in Payson, Santaquin, and Nephi and between Salem and Payson. Along the portion of the alignment that goes through Nephi, residences would be within 10 feet of construction. These residences would be exposed to construction noise levels exceeding 67 dBA, causing temporary, significant impacts. Standard construction procedures call for daytime construction only; thus, no noise impacts would occur at night.

The noise levels produced by construction activities within the Diamond Fork drainage would be similar to those shown in Table 3.11-2. There would be few sensitive human receptors within immediate work areas, and impacts from temporary construction noise would not likely have an impact on nearby public areas.

3.11.6.2.2.2 Operational Impacts. The only potential noise impact resulting from operation of the Proposed Action would be generated by the West Mona Pumping Plant. Because the pumping plant would be constructed in accordance with applicable noise standards and no sensitive receptors are located nearby, operation of the pumping plant would not cause a significant impact.

3.11.6.2.3 Related Actions (Local Development). The following sections describe the construction- and operation-related impacts that could result from related actions (e.g., local distribution and on-farm systems) developed as a result of the Proposed Action. These impacts are summarized in Section 3.11.6.9.

3.11.6.2.3.1 Distribution Systems. Construction of distribution systems would be on a much smaller scale than that of the "Diamond Fork Tunnel Alternative" and Main Conveyance Aqueduct. The pressurized secondary water system, as described in Appendix C, *Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template*, would also require a much smaller scale of construction. Standard safety procedures would be followed during construction for both local and M&I development, and no significant impacts would occur.

Operation of new distribution systems would be beneficial to public safety. Certain existing open canals would be converted to buried pipelines, reducing the potential for drowning. If Bonneville Unit water delivered to local municipalities were to be used for potable purposes, adverse impacts to public health and safety could occur. However, analysis of impacts associated with the treatment and distribution of the M&I water for domestic use would be the responsibility of the receiving municipality. Any secondary water system that uses non-potable water for irrigation must have all outlets labeled as required by the Utah Uniform Plumbing Code.

The Nephi Pumping Plant would be constructed in accordance with applicable noise standards. Therefore, noise emitted from the Nephi Pumping Plant would not cause a significant impact.

3.11.6.2.3.2 On-Farm Systems. The overall composition of the types of pesticides used on farmlands would change as a result of crop conversion, as discussed in Section 3.9, Agriculture. However, no significant impact to water quality is expected. Public exposure associated with increased pesticide use is not expected to be significant as standard safety procedures for application would be followed.

3.11.6.2.4 Mitigation. Warning signs would be posted and the entrance clearly marked at the Spanish Fork trailhead parking area. Stop signs would be posted for trail users crossing the tracks at the Spanish Fork trailhead railroad crossing. Negotiations with the railroads would ensure that trains approaching the bend would sound a warning to trail users.

3.11.6.2.5 Unavoidable Adverse Impacts. Sensitive receptors within 400 feet of construction activities would be exposed to high levels of noise. Most of the noise impacts would be to residents in Nephi. Adverse impacts would also occur during an earthquake or a major pipeline rupture. If an earthquake caused major widespread destruction such that the pipeline were to rupture and stop valves could not be reached, water from the pipeline could add to the area's destruction. Short-term, localized PM_{10} standards would be exceeded during construction and could result in short-term unavoidable adverse impacts to public health.

3.11.6.3 MCAPW-DFT Alternative

Impacts resulting from the construction and operation of the MCAPW-DFT Alternative would be similar to those described under the Proposed Action. However, there would be no impacts associated with the recreation trail, nor would there be beneficial impacts as a result of local development canal removal.

3.11.6.4 MCAP Alternative

3.11.6.4.1 Impacts. Impacts resulting from the construction and operation of the MCAP Alternative would be similar to those described for the Proposed Action. However, under this alternative, Monks Hollow Dam and Reservoir would be constructed instead of the "Diamond Fork Tunnel Alternative." The development of Monks Hollow Dam and Reservoir would have similar construction-related impacts as those identified for the Proposed Action. However, additional operational impacts could occur, as discussed below. Construction- and operation-

associated impacts of the Main Conveyance Aqueduct and related actions would be identical to those described for the Proposed Action.

The potential for dam rupture or failure would be extremely low. Seismic studies would be conducted to determine the best design, and the dam would be constructed to withstand any expected seismic event in the area. Therefore, Monks Hollow Dam would not pose a credible threat to public safety.

The development of Monks Hollow Reservoir would result in a publicly accessible mountain reservoir. Vehicular access to the reservoir would be limited to a few locations; however, hikers, bikers, and equestrians could access much of the reservoir shoreline. The reservoir would be used for recreational purposes, and the inherent public safety risks associated with an open body of water (e.g., potential for drownings) would exist. Because of the potential for loss of life, this risk is considered a significant threat (impact) to public health and safety.

Noise would occur as a result of construction activities and construction-related traffic. As discussed, there are few sensitive receptors in the Diamond Fork drainage and public access would be limited periodically during the construction period. Therefore, no significant impacts to the noise environment are expected.

3.11.6.4.2 Mitigation. To reduce the potential for drownings in Monks Hollow Reservoir, marker buoys and float lines would be installed around spillway intake structures.

3.11.6.4.3 Unavoidable Adverse Impacts. The inherent drowning risks associated with Monks Hollow Reservoir would be unavoidable.

3.11.6.5 MCAPW Alternative

Public health and safety and noise impacts under the MCAPW Alternative and Main Conveyance Aqueduct would be similar to those associated with the Proposed Action. Under the MCAPW Alternative, Monks Hollow Dam and Reservoir would be constructed, and the resulting impacts would be the same as those described under the MCAP Alternative. Additionally, because distribution systems associated with this alternative would be less extensive than under the Proposed Action, any associated impacts would also be reduced. The recreation trail would not be constructed.

3.11.6.6 MCATC Alternative

Public health and safety and noise impacts under the MCATC Alternative would be similar to those associated with the Proposed Action. However, under the MCATC Alternative, Monks Hollow Dam and Reservoir would be constructed and the resulting impacts would be the same as those described under the MCAP Alternative. The recreation trail would not be constructed.

3.11.6.7 MCAT Alternative

Public health and safety and noise impacts under the MCATC Alternative would be similar to those associated with the Proposed Action. However, under the MCATC Alternative, Monks Hollow Dam and Reservoir would be constructed and the resulting impacts would be the same as those described under the MCAP Alternative. Distribution systems associated with this alternative would be less extensive than under the Proposed Action; therefore any associated impacts would also be reduced. The recreation trail would not be constructed.

3.11.6.8 No Action Alternative

The following sections describe the construction- and operation-related impacts resulting from the No Action Alternative. These impacts are summarized in Section 3.11.6.9. The recreation trail would not be constructed.

As a result of the No Action Alternative, the SFN System would not be built. However, under this alternative, Three Forks Dam and Reservoir would be constructed. The public health and safety threat (impact) associated with Three Forks Reservoir would be similar, but much smaller in scale, to those described for Monks Hollow Dam under the MCAP Alternative.

Under the No Action Alternative, flows in the Spanish Fork River and Diamond Fork Creek would increase, resulting in lower average and peak TDS concentrations, reduced turbidity and total phosphorus, and increased dissolved oxygen levels. The water quality of these areas, as well as the water quality in Benjamin Slough, would improve slightly from baseline conditions. These increased flows are not expected to be a drowning hazard.

3.11.6.8.1 Mitigation. None.

3.11.6.8.2 Unavoidable Adverse Impacts. No unavoidable adverse impacts are expected to occur.

3.11.6.9 Summary of Impacts

A summary of impacts for the Proposed Action and the MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives is presented in Table 3.11-3.

Table 3.11-3
Summary of Impacts Affecting Public Health & Safety/Noise

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Resource	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Water Quality	Potential increases in trace elements	Not significant	None	Not significant
Air Quality	Potential exceedences of PM_{10} levels could affect public health.	Significant (short-term)	None	Significant (short-term)
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Not significant	Design against seismic failure	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
Canal Replacement	Canal replacement would lessen potential of drownings.	Significant	None	Significant

Table 3.11-3
Summary of Impacts Affecting Public Health & Safety/Noise

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Resource	Impact	Significance	Mitigation	Significance After Mitigation
MCAPW-DFT Alternative				
Water Quality	Potential increases in trace elements.	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Significant
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
MCAP Alternative				
Water Quality	Potential increases in trace elements.	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Significant
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design.	Significant
Reservoir Drownings	Potential for drownings in Monks Hollow Reservoir.	Significant	Marker buoys and float lines would be installed around spillway intake structures.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
Canal Replacement	Canal replacement would lessen potential of drownings.	Significant	None	Significant

Table 3.11-3
Summary of Impacts Affecting Public Health & Safety/Noise
Page 3 of 4

Resource	Impact	Significance	Mitigation	Significance After Mitigation
MCAPW Alternative				
Water Quality	Potential increases in trace elements.	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Significant
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design.	Significant
Reservoir Drownings	Potential for drownings in Monks Hollow Reservoir.	Significant	Marker buoys and float lines would be installed around spillway intake structures.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
MCATC Alternative				
Water Quality	Potential increases in trace elements.	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Significant
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design.	Significant
Reservoir Drownings	Potential for drownings in Monks Hollow Reservoir.	Significant	Marker buoys and float lines would be installed around spillway intake structures.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant

Table 3.11-3
Summary of Impacts Affecting Public Health & Safety/Noise
Page 4 of 4

Resource	Impact	Significance	Mitigation	Significance After Mitigation
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
Canal Replacement	Canal replacement would lessen potential of drownings.	Significant	None	Significant
MCAT Alternative				
Water Quality	Potential increases in trace elements	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Not significant
Pipeline Rupture	Potential for pipeline rupture to threaten public safety.	Significant	Proper design.	Significant
Reservoir Drownings	Potential for drownings in Monks Hollow Reservoir.	Significant	Marker buoys and float lines would be installed around spillway intake structures.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant
Recreation Trail Access	Potential public safety threats at Highway 6 and railway crossing at Spanish Fork trailhead.	Significant	Signs would be posted; approaching trains would sound warning.	Not significant
Construction Noise	Pipeline construction noise could create a disturbance near populated areas.	Significant	None	Significant
No Action Alternative				
Water Quality	Improvements to water quality in some areas.	Not significant	None	Not significant
Air Quality	Potential short-term exceedences of PM_{10} levels could affect public health.	Significant	None	Not significant
Reservoir Drownings	Potential for drownings in Three Forks Reservoir.	Significant	Marker buoys and float lines would be installed around spillway intake structures.	Significant
Reservoir Failure	Potential for reservoir embankment or dam failure to threaten public safety.	Significant	Design against seismic failure.	Significant

3.11.6.10 Cumulative Impacts

Projects to be considered for cumulative impacts associated with both their development and the development of the SFN System are identified in Section 1.8. Public health and safety impacts associated with the SFN System are minimal and primarily result from the introduction of potential risks, not direct impacts to public health and safety within the impact area of influence. Public health and safety impacts associated with the projects identified in Section 1.8 would also be minimal and would not likely be additive with those resulting from the SFN System; therefore, no cumulative impacts would be expected.

Potential noise impacts from the SFN System would occur only during construction activities. It is possible that noise resulting from the construction of the Nephi Airport expansion could occur at the same time SFN System construction would take place in the Nephi area. However, this timing is unlikely, and impacts would not be significant.

3.12 Socioeconomics

3.12.1 Introduction

This section addresses potential impacts to social and economic systems that would occur as a result of construction and operation of the SFN System and distribution and on-farm systems and the availability of Bonneville Unit water agricultural and M&I uses. Socioeconomic conditions and potential impacts are addressed based on an assessment of the following topics:

- Employment
- Income
- Population
- Public services and related fiscal impacts
- Housing

3.12.2 Issues Eliminated from Further Analysis

No issues were eliminated from further analysis.

3.12.3 Issues Addressed in the Impact Analysis

3.12.3.1 Issues Raised During Scoping

The following issues are based on input received during the scoping process and are addressed in the socioeconomic impact analysis:

- Potential short- and long-term effects of the SFN System on employment
- Potential economic impacts to the agricultural sector in the local area
- Potential impacts on local income from increased recreational use
- Potential impacts from M&I water development and use

3.12.3.2 Other Issues Raised

Issues raised outside of the scoping process and addressed in this analysis are identified below:

- Increases or decreases in population or a shift in population among counties as a result of the SFN System

- Increases in the demand for temporary housing, such as hotels and other short-term residences, or increases or decreases in the demand for long-term housing in the local area as a result of the SFN System

- Changes to the tax base from which communities in the local area collect revenue as a result of the SFN System

- Declines in the quality or level of public services as a result of the SFN System

3.12.4 Description of Impact Area of Influence

3.12.4.1 Regional Area

Because there is more than a sufficient supply of labor from within Salt Lake, Utah, and Juab Counties to construct and operate the SFN System, it is likely that the entire construction crew would commute from within this "regional" impact area of influence. This regional area will serve as the impact area of influence for the purpose of analyzing potential impacts to employment and personal income as a result of SFN System construction.

3.12.4.2 Local Area

Because the SFN System and the distribution and on-farm systems would be located in Utah and Juab Counties, it has been assumed that operation-related socioeconomic impacts would impact only these two counties and not Salt Lake County. Therefore, Utah and Juab Counties have been defined as the "local" impact area of influence and were studied for impacts to total employment, total personal income, population, public services and related fiscal impacts, and housing.

3.12.5 Affected Environment

The economies of Salt Lake, Utah, and Juab Counties differ in that Juab County is agrarian, Salt Lake County has developed into a major financial and trade center, and Utah County contains a combination of each, with urban centers in Provo and Orem and agricultural development in the southern part of the county. Since the Proposed Action and alternatives are located in the same regional and local area, the following discussion applies to the Proposed Action and each of the alternatives.

The following sections provide a summary of the socioeconomic environment of the impact area of influence and provide baseline projections of economic and social activity over the longest construction period (10 years). These projections are based on the best estimates of State and local planning agencies and do not assume the development of the SFN System.

The discussion has been divided into two categories: regional area and local area. The regional area discussion focuses on impacts related to the hiring of construction labor, while the local area discussion concentrates on the socioeconomic impacts to that specific area.

The Proposed Action construction schedule (refer to Figure 1-18 in Chapter 1) shows that the greatest expenditures of labor would occur in the first quarter of 2003. During this period, concurrent construction of the Salem Bench Pipeline, Payson Pipeline, Red Hollow Pipeline, and South Field Canal would require a peak annual employment of 105 workers. For purposes of analysis, the baseline employment year will be specified as 2005. This will coincide with baseline projections of population and employment provided by the Utah Office of Planning and Budget (OPB) at 5-year intervals. The peak construction employment for each alternative (occurring in 2003 in all cases) will be compared to the 2005 baseline.

3.12.5.1 Regional Area

3.12.5.1.1 Employment. An estimate of baseline total employment in the regional area for 2005 is provided in Table 3.12-1. It shows that out of a total of 742,375 jobs in the regional area in the peak baseline year, 28,232 would be construction-related.

3.12.5.1.2 Personal Income. An estimate of personal income for the regional area and includes the construction sector as well as the total of all sectors during the peak year is also provided in Table 3.12-1. The estimate is based on historical income and projections of employment in 2005 and is adjusted for inflation.

Table 3.12-1
2005 Regional Area Baseline Employment and Personal Income

Employment Sector	Jobs[a]	Aggregate Personal Income[b]	Average Annual Wage
Construction	28,232	$1,432,251,000	$50,731
Other	714,143	$25,486,400,000	$35,688
Total	**742,375**	**$26,918,651,000**	**--**

[a]*Utah Economic and Demographic Projections 1994* (OPB 1994), adjusted to include non-farm proprietors based on approach provided by Utah Office of Planning and Budget (OPB).
[b]Developed using historical income data from *Statistical Abstract of Utah 1993* (BEBR 1993).

3.12.5.2 Local Area

3.12.5.2.1 Employment. An estimate of total employment in the local area is provided in Table 3.12-2. Because impacts on agriculture from the delivery of Bonneville Unit water would be long-term impacts, the estimates in Table 3.12-2 have been provided from 1995 through 2010 to show a trend. Based on these projections, the average annual growth in total employment is 2.3 percent. These estimates were developed by the OPB, which surveyed employers in 1994 to obtain economic growth assumptions. The projections made by the employers did not consider the construction of the SFN System or the introduction of supplemental irrigation water. Thus, it is reasonable to assume that population growth in the local area would be stimulated by these projected jobs and not necessarily the construction and operation of the SFN System and distribution and on-farm systems.

Table 3.12-2
Local Area Baseline Employment

Employment Sector	1995	2000	2005	2010
Agriculture	3,423	3,616	3,747	3,922
Other	130,966	148,066	165,755	185,416
Total Employment	**134,389**	**151,682**	**169,502**	**189,338**

Sources: *Utah Economic and Demographic Projections 1994* (OPB 1994), adjusted to include non-farm proprietors based on approach provided by OPB.

3.12.5.2.2 Income

3.12.5.2.2.1 Personal Income. An estimate of the local area (i.e., Utah and Juab Counties) baseline personal income is provided in Table 3.12-3. The forecast is based on estimates of employment from OPB (OPB 1994) and the estimate of personal income from the University of Utah (BEBR 1993).

Table 3.12-3
Local Area Aggregate Baseline Personal Income

	1995	2000	2005	2010
Total Personal Income	$3,051,558,000	$4,026,103,000	$5,264,672,000	$6,973,758,000

Sources: Developed using historical personal income data from *Statistical Abstract of Utah 1993* (BEBR 1993) and extrapolating total income based on employment projections from *Economic and Demographic Projections 1994* (OPB 1994). Figures are adjusted for inflation using gross domestic product (GDP) deflator projections provided in WEFA Group, *The Electric Utility Cost Service Forecast and Analysis*, Winter/Spring 1994 (WEFA Group 1994).

3.12.5.2.2.2 Farm Income. An estimate of a representative baseline farm budget on a per acre basis is provided in Table 3.12-4. This baseline farm budget was estimated using the representative farms identified in Section 3.9, Agriculture, and input from the NRCS (Anderson et al. 1996c). The budget shows that apples are the most profitable crop. However, because apple orchards require specific water and drainage conditions and because urbanization increases land values, there are limitations to the development of these crops in the local area. Lands that would be appropriate for conversion to this crop type are identified on Map 1-11 in Chapter 1.

3.12.5.2.3 Population. An estimate of future population levels through the year 2045 for the local area is provided in Table 3.12-5. The estimates were provided to the CUWCD by the Utah OPB (Wimmer 1995). The projections show that growth will likely occur in the local area whether or not the SFN System is constructed.

3.12.5.2.4 Social Environment. Typically, the social environment is defined by specific groups or classes of people within the impact area of influence. Social groups are generally defined by their lifestyle (e.g., patterns of work and leisure, customs and traditions, and relationships with family, friends, and others) and their attitudes, beliefs, and values (e.g., preferences, expectations, sense of freedom, self-sufficiency, and certainty about the future). Social groups within the local area are categorized into four groups: local residents (both long- and short-term), local farmers and ranchers, property owners, and conservationists.

3.12.5.2.4.1 Local Residents. Long-time local residents are those individuals and their families and employees who have lived in the local area at least 10 to 15 years. Newcomers are defined as those individuals and their families, mostly young, who have moved into the area because of lifestyle or affordability and who may commute to cities outside the local area for employment.

3.12.5.2.4.2 Local Irrigators and Ranchers. Local irrigators and ranchers are typically long-standing residents whose income is generally derived from agriculture. They have close ties to the community and may be active in politics, especially any political activity affecting their livelihoods.

3.12.5.2.4.3 Property Owners. Property owners are usually owner-occupants (typically concerned about any potential projects that could change the value of their property) or investors from outside who have purchased land for speculative purposes or with the intent of developing it in the future.

3.12.5.2.4.4 Conservationists. Conservationists represent a widespread, diverse group united by a strong commitment to the preservation and protection of the environment. This group can be highly vocal and willing to devote a great deal of time and effort to causes in which they believe.

Table 3.12-4
Baseline Farm Income Within the Impact Area of Influence

	Alfalfa	Barley	Corn Grain	Corn Silage	Alfalfa Establishment		Dryland Wheat	Tart Cherries	Apples
					Oat Hay	Aftermath			
Receipts:									
Unit of Yield per Acre	Tons	Bushels	Bushels	Tons	Tons	AUMs	Bushels	Pounds	Pounds
Yield per Acre	3.8	90	100	20	2.5	4	25	10,000	18,500
Price per Unit of Yield	$90.00	$2.75	$3.20	$20.00	$75.00	$10.00	$4.25	$0.15	$0.15
Total Receipts ($ per acre)	$342	$248	$320	$400	$188	$40	$106	$1,500	$2,775
					$228				
Expenses ($ per acre):									
Land Preparation		$34	$59	$59		$34	$17	$15	$15
Planting		45	90	90		45	46	350	650
Harvesting	$190	40	40	80		100	12	260	550
Irrigation									
Shares	20	20	20	20		20	0	20	20
System	20	20	20	20		20	0	200	300
Irrigate	6	5	14	14		3	0	20	30
Crop Establishment	10							250	300
Management	10	10	10	10		10	8	10	15
Interest on Operating Capital	15	15	15	15		10	5	50	85
Miscellaneous	10	10	10	10		10	5	20	20
Total Expenses ($ per acre):	$281	$199	$278	$318		$252	$93	$1,195	$1,985
Net Profit ($ per acre):	$61	$49	$42	$82		$-24	$13	$305	$795

Note: Values from NRCS data, Utah State Extension, and interviews with area irrigators (Anderson et al. 1996c). Yields equal to average baseline yields.

Table 3.12-5
Local Area Baseline Population

	1995	2005	2015	2025	2035	2045
Total Population	316,984	378,027	439,534	501,341	565,887	634,437

Source: Wimmer 1995. Note that the population forecasts in this source end at 2035. The long-term annual rate of growth (1.15 percent) is assumed to remain constant for the period from 2035 to 2045.

3.12.5.2.5 Public Services

3.12.5.2.5.1 ***Education.*** The five school districts in Utah and Juab Counties are made up of 84 schools. The average pupil-teacher ratio for the districts in the two counties was 26:1 in 1994. Alpine School District in American Fork and Nebo School District in Spanish Fork are the two largest districts in Utah County with enrollments of 40,000 and 17,000 students, respectively (Utah State Office of Education 1994).

3.12.5.2.5.2 ***Health Care.*** According to the University of Utah (*1993 Statistical Abstract*, Tables 2.7 and 2.8 [BEBR 1993]), the Mountainland District, which includes Utah County, has five hospitals with 645 average patient beds per year. The largest of these hospitals is Utah Valley Regional Medical Center with 395 beds. Average occupancy in 1990 for the hospitals in the Mountainland District was 56.6 percent. As of 1990, there were 364 non-federal physicians in the Mountainland District, with 328 in Utah County.

The Central District, which includes Juab County, has six hospitals with 160 average patient beds per year. The total number of beds ranges from 20 to 40 for each hospital. Average occupancy in 1990 for the hospitals in the Central District was 19.1 percent. As of 1990, there were 32 non-federal physicians in the Central District, with 5 in Juab County.

3.12.5.2.5.3 ***Tax Base.*** Fiscal year 1991 income tax collections in the local area were estimated at $85 million. Property taxes of $70.6 million were charged in the local area in 1990 (MacDonald 1994).

3.12.5.2.6 Housing. Estimates from the Utah Association of Realtors (Walker 1994) of the average sale price of homes have been used to determine representative housing values in the local area. The average sale price is approximately $125,000, as shown in Table 3.12-6. The number of homes is approximately 90,000. These projections are based on an assumed vacancy rate of 5 percent and on the percentage of change in the population projections.

Table 3.12-6
Local Area Housing Availability

	Forecast					
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Median Home Value[a]	$123,016	$144,023	$168,557	$199,576	$236,271	$279,875
Total Housing Units[b]	90,008	98,632	107,274	117,778	124,716	133,113

[a]1995 estimate based on average of first three quarters of 1994 for Central Utah (Walker 1994). Forecasts based on 1995 estimate adjusted for inflation using GDP deflator projections provided in *The Electric Utility Cost Service Forecast and Analysis, Winter/Spring 1994* (WEFA 1994).
[b]From Table 11.9 in *Statistical Abstract of Utah 1993* (BEBR 1993). Forecast based on change in population projections in Table 3.12-5 and assumes a vacancy rate of 5 percent.

3.12.6 Impact Analysis

3.12.6.1 Significance Criteria

The socioeconomic significance criteria are based on professional judgement and involvement in other projects subject to the provisions of NEPA. An impact would be considered significant if particular conditions would occur as a result of the construction and operation of the Proposed Action or alternatives. The significance criteria used in the socioeconomic impact analysis are listed in Table 3.12-7.

Table 3.12-7
Significance Criteria for Socioeconomic Impacts

Area/Impact Topic	Significance Criteria
Regional Area	
Employment	A change greater than 10 percent in construction employment
Personal Income	A change greater than 10 percent in personal income to the construction labor sector
Local Area	
Employment	A change greater than 10 percent in employment
Personal Income	A change greater than 10 percent
Population	A change greater than 10 percent in population
Public Services and Related Fiscal Impacts	A change greater than 10 percent in tax revenue collected and level or quality of public services
Housing	A change greater than 10 percent in demand for housing
Social Environment	1) If the project would force a major change in lifestyle for some or all persons in any of the social groups identified within the local area 2) If the project would severely conflict with the attitudes, beliefs, and values of a large percentage of those residing within, or with interest in, the local area 3) If the project would bring about a severe disruption in the degree of cooperation between segments of the community.

3.12.6.2 Potential Impacts Eliminated from Further Analysis

The following issues have been eliminated from further analysis.

- Potential short- and long-term effects of the SFN System on employment

Based on past history and current projects in southern Utah County, it is assumed that the construction work force would commute from within the regional area. It is also assumed that the CUWCD would use its own employees to perform operation and maintenance duties. Thus, no change or shift in regional baseline population is expected to result from the construction of the SFN System and any construction employment impacts would be short-term in nature.

Based on discussions with irrigators in the local area (Cook et al. 1996; Anderson et al. 1996c), new farm-related employment that would occur as a result of the increase in agricultural production from water deliveries would be negligible. Supplemental water from the SFN System would increase the number of crops grown in a year, thus lengthening the growing season, but it would not increase the demand for labor by any measurable amount.

Employment impacts to the regional area will be examined further in this section, but no further analysis will be undertaken to estimate local area employment impacts.

- Potential increases or decreases in population in the local area or a shift in population among counties as a result of the SFN System

Baseline estimates in Tables 3.12-2 and 3.12-5 show that growth in employment and population is expected in the local area, even without the SFN System, and no population increases are expected as the result of farm labor or construction labor as explained above. Need for the SFN System, as identified in Section 1.3 in Chapter 1, is to supply a limited amount of M&I water to meet projected growth demands and to supply supplemental irrigation water. Agricultural water that would be delivered by the SFN System would be contracted for that sole purpose; any proposed changes in water use would require contract revisions and would necessitate additional environmental review.

Construction employment would occur over a 10-year period and would be provided by local and regional construction workers who would commute to the job sites. Construction and operation of the SFN System would not induce growth in the local or regional area. Also, interviews with local area irrigators indicate that there would be no increase in farm labor as a result of supplemental water supplies. Growth-inducing impacts, therefore, are not addressed in any further detail.

- Increases in the demand for temporary housing, such as hotels and other short-term residences, or an increase or decrease in the demand for long-term housing in the local area as a result of the SFN System
- Declines in the quality or level of public services as a result of the SFN System

With no expected change or shift in population, impacts on housing and public services as a result of the SFN System would not occur.

3.12.6.3 Proposed Action

The following sections describe construction- and operation-related impacts that would result from the Proposed Action. These impacts are summarized in Section 3.12.6.10.

3.12.6.3.1 Regional Area Employment. This section discusses both direct and indirect employment impacts on the regional area as a result of the construction of the Proposed Action.

3.12.6.3.1.1 Construction Employment. The estimated direct employment from construction of the Proposed Action and alternatives is shown in Table 3.12-8. Impacts have been estimated by comparing the projected employment figures with baseline figures and calculating the average percentage increase. Employment associated with construction of the Proposed Action and alternatives would be greatest in the year 2003 (see Figures 1-18, 1-19, and 1-22).

During the peak construction period, the Proposed Action would employ 30 people in the construction of the "Diamond Fork Tunnel Alternative," 60 people in the construction of the Main Conveyance Aqueduct, and 15 people in the construction of the distribution and on-farm systems. The total construction employment of 105 employees would be less than 1 percent of total baseline construction employment. This falls below the significance criterion of 10 percent and is therefore not considered a significant impact.

3.12.6.3.1.2 Indirect Employment. Indirect employment as a result of total construction employment has been estimated using an indirect multiplier from the Bureau of Economic and Business Research at the University of Utah. Total direct and indirect employment resulting from the Proposed Action would equal 325 jobs in the peak year. This represents less than 1 percent of all baseline employment in the regional area. Because this estimate is below the 10 percent significance criterion, this is not considered a significant impact.

3.12.6.3.1.3 Regional Area Personal Income (Construction Labor). Direct and indirect construction-related income impacts that would occur as a result of the construction of the Proposed Action have been studied on the regional level and are presented in this section.

Table 3.12-8 Peak Year Regional Area Employment Impacts–Jobs									
	Baseline Employment	Proposed Action and MCAPW-DFT Alternative		MCAP and MCAPW Alternatives		MCATC Alternative		MCAT Alternative	
		Jobs	Increase over Baseline	Jobs	Increase over Baseline	Jobs	Increase over Baseline	Jobs	Increase over Baseline
Total Regional Area Construction Employment	28,232	105	<1%	160	<1%	250	<1%	220	<1%
Other (Indirect) Employment	714,143	220	<1%	335	<1%	523	<1%	460	<1%
Total Direct and Indirect Employment	742,375	325	<1%	495	<1%	773	<1%	680	<1%
Source: Baseline estimates from Table 3.12-1.									

Employment Income. The estimated personal income associated with the Proposed Action and alternatives is shown in Table 3.12-9. Impacts were calculated by comparing projected income figures with baseline figures and calculating the average percentage increase.

Table 3.12-9 Peak Year Regional Area Personal Income Impacts													
	Average Annual Wage[a]	Proposed Action and MCAPW-DFT Alternative			MCAP and MCAPW Alternatives			MCATC Alternative			MCAT Alternative		
		Jobs[b]	Income[c]	Increase over Baseline[d]	Jobs[b]	Income[c]	Increase over Baseline[d]	Jobs[b]	Income[c]	Increase over Baseline[d]	Jobs[b]	Income[c]	Increase over Baseline[d]
Construction	$50,731	105	$5,326,755	<1%	160	$8,116,960	<1%	250	$12,682,750	<1%	220	$11,160,820	<1%
Other (Indirect)	$35,688	220	$7,851,360	<1%	335	$11,955,480	<1%	523	$18,664,824	<1%	460	$16,416,480	<1%
Total	--	325	$13,178,115	<1%	495	$20,072,440	<1%	773	$31,347,574	<1%	680	$27,577,300	<1%
[a]From Table 3.12-1. [b]From Table 3.12-8. [c]Product of values shown in Jobs and Average Annual Wage columns. [d]Baseline income found in Table 3.12-1.													

Total peak year construction personal income is estimated at $5,326,755, which is less than 1 percent of baseline construction income. Therefore, no significant impacts would occur.

Indirect Income. Total indirect income from the Proposed Action would equal $7,851,360 in the peak year. Direct and indirect income would total $13,178,115 and represent an increase of less than 1 percent over the total baseline income of $26,918,651,000. Because this falls below the 10 percent significance criterion, there would be no significant impacts.

3.12.6.3.2 Local Area

3.12.6.3.2.1 Farm Income. Agricultural impacts were studied for those areas that would receive a Bonneville Unit water supply as described in Section 3.9, Agriculture. Farm income based on an estimated representative farm budget under the Proposed Action and alternatives is shown in Table 3.12-10. The table shows anticipated

net profits under both types of improved irrigation, sprinkler and flood. The method of irrigation that would be used for each general land area is summarized in Section 3.9, Agriculture.

Table 3.12-10
Farm Income with the Proposed Action and Alternatives

Item	Alfalfa	Barley	Corn Grain	Corn Silage	Alfalfa Establishment		Wheat	Tart Cherries	Apples
					Oat Hay	Aftermath			
Receipts:									
Unit of Yield per Acre	Tons	Bushels	Bushels	Tons	Tons	AUMs	Bushels	Pounds	Pounds
Yield per Acre	4.7	110	125	25	3	5	25	13,000	21,500
Price per Unit of Yield	90.00	2.75	3.20	20.00	75.00	10.00	4.25	0.15	0.15
Total Receipts ($ per Acre)	$423	$303	$400	$500	$225	$50	$106	$1,950	$3,225
					$275				
Expenses ($ per acre):									
Land Preparation		$34	$59	$59		$34	$17	$15	$15
Planting		51	102	102		51	46	450	750
Harvesting	$230	45	45	100		120	12	350	600
Irrigation									
Shares	20	20	20	20		20	0	25	20
System	0	0	10	10		0	0	200	300
Irrigate	4	7	20	20		5	0	30	40
Crop Establishment	10	0	0	0		0		325	400
Management	10	10	10	10		10	8	20	20
Interest on Operating Capital	15	15	15	15		10	5	100	100
Miscellaneous	10	10	15	15		10	5	20	20
SFN System Expenses:									
Distribution System	15	15	15	15		15		15	15
Sprinkler System	38	40	40	40		40		75	75
Total Expenses ($ per acre):	$352	$247	$351	$406		$315	$93	$1,625	$2,355
Net Profit ($ per acre):	$71	$56	$49	$94		$-40	$13	$325	$870

Note: Values from NRCS data, Utah State Extension, and interviews with area irrigators (Anderson et al. 1996c). Yield equal to average Proposed Action yield.

Based on the calculations presented in Table 3.12-10, the net profit for all crop types, with the exception of oat hay, would increase from that identified under baseline conditions (see Table 3.12-4). In most cases, farm budgets for the farms on affected lands would increase more than 20 percent. Changes in farm budgets from the baseline are summarized in Table 3.12-11.

Table 3.12-11
Change in Farm Income Resulting from the Proposed Action and Alternatives

Item	Alfalfa	Barley	Corn Grain	Corn Silage	Alfalfa Establishment		Wheat	Tart Cherries	Apples
					Oat Hay	Aftermath			
Receipts:									
Unit of Yield per Acre	Tons	Bushels	Bushels	Tons	Tons	AUMs	Bushels	Pounds	Pounds
Yield per Acre	0.9	20	25	5	0.5	1	0	3,000	3,000
Total Receipts ($ per acre):	$81	$55	$80	$100	$37	$10	$0	$450	$450
					$47				
Expenses ($ per acre):									
Land Preparation		$0	$0	$0		$0	$0	$0	$0
Planting		6	12	12		6	0	100	100
Harvesting	$40	5	5	20		20	0	90	50
Irrigation									
Shares	0	0	0	0		0	0	5	0
System	-20	-20	-10	-10		-20	0	0	0
Irrigate	-2	2	6	6		2	0	10	10
Crop Establishment	0	0	0	0		0		75	100
Management	0	0	0	0		0	0	10	5
Interest on Operating Capital	0	0	0	0		0	0	50	15
Miscellaneous	0	0	5	5		0	0	0	0
SFN System Expenses:									
Distribution System	15	15	15	15		15		15	15
Sprinkler System	38	40	40	40		40		75	75
Total Expenses ($ per acre):	$71	$48	$73	$88		$63	$0	$430	$370
Net Profit ($ per acre):	$10	$7	$7	$12		$-16	$0	$20	$80

As shown on Table 3.12-12, farm income in the impact area of influence would increase from $5.3 million to $6.7 million, an increase of approximately 25 percent. This $1.4 million increase, however, would be an increase of less than 1 percent in total personal income for the local area and would fall below the 10 percent significance criterion. Applying the indirect income multiplier of 2.8475 yields a total personal income benefit of $3.8 million. This would also result in an impact of less than 1 percent on total income and would fall below the 10 percent significance criterion.

3.12.6.3.2.2 Fiscal Impacts. This section summarizes the impacts that would occur to the local area economy as a result of economic impacts of the recreation trail, increased angler-use (identified in Section 3.10, Recreational Resources), and economic and social impacts of the M&I System.

Recreational Impacts. Recreational impacts would include those resulting from increased angler-use and from the recreation trail.

Table 3.12-12
Agricultural Production Income Impacts per Year Resulting from the Proposed Action and Alternatives

Crop	Southern Utah County				Eastern Juab County				Affected Area Total			
	Baseline	Proposed Action	Change in Income	Percent Change	Baseline	Proposed Action	Change in Income	Percent Change	Baseline	Proposed Action	Change in Income	Percent Change
Alfalfa	$745,969	$911,427	$165,458	22	$347,395	$899,357	$551,962	159	$1,093,364	$1,810,784	$717,420	66
Barley	158,613	97,680	(60,933)	(38)	38,122	133,089	94,967	249	196,735	230,769	34,034	17
Corn Grain	32,886	45,815	12,929	39	1,596	1,862	266	17	34,482	47,677	13,195	38
Corn Silage	130,544	179,446	48,902	37	26,486	88,548	62,062	234	157,030	267,994	110,964	71
Oat Hay	(4,584)	(20,640)	(16,056)	(350)	(15,432)	(29,760)	(14,328)	(93)	(20,016)	(50,400)	(30,384)	(152)
Wheat	1,000	0	(1,000)	(100)	109,000	0	(109,000)	(100)	110,000	0	(110,000)	(100)
Cherries	1,159,610	1,183,000	23,390	2	NA	NA	NA	NA	1,159,610	1,183,000	23,390	2
Apples	2,574,210	3,166,800	592,590	23	NA	NA	NA	NA	2,574,210	3,166,800	592,590	23
Total	$4,798,248	$5,563,528	$765,280	16	$507,167	$1,093,096	4585,929	116	$5,305,415	$6,656,624	$1,351,209	25

Note: Numbers with ( ) indicate a negative change.
*All amounts shown in dollars unless otherwise noted.

Angler-Use. Section 3.10, Recreational Resources, identified increases in angler-use in the impact area of influence. The impact of increased angler-use days per year resulting from improved aquatic habitat was calculated by alternative and is shown in Table 3.12-13.

Table 3.12-13
2005 Fiscal Impacts of Angler-Use Resulting from the Proposed Action and Alternatives

	Baseline	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative*	MCAPW Alternative*	MCATC Alternative*	MCAT Alternative*	No Action Alternative
Total Angler-Use Days per Year	7,816	39351	39270	34164	33920	34164	33920	31513
Total Annual Fiscal Impact	$256,742	$1,292,668	$1,290,017	$1,122,286	$1,114,279	$1,122,286	$1,114,279	$1,035,188
Percentage Increase from Baseline	NA	403	402	337	334	337	334	303

*Estimates include angler-use days referenced from Section 3.10, Recreational Resources. The total annual fiscal impact is the product of the total angler-use days and the average angler-day expenditure. The average angler-day expenditure in 2005 is estimated at $32.85 (McCollum 1997).

Although there are significant increases in benefits of angler-use over the baseline (see Table 3.12-13), the overall impact on the economy would be negligible. For the Proposed Action, angler-use would increase by 403 percent over baseline angler-use, resulting in an annual impact of $1,035,926. This, however, is less than 1 percent of baseline income for the local area and falls below the 10 percent significance criterion. Therefore, while the increase in angler-use would be significant, the economic impact associated with increased angler-use would not be significant.

Recreation Trail. Potential economic impacts to the local area from the recreation trail would include possible increases in property values for those areas close to the trail and the resulting increases in property tax income. Other social and economic impacts that would be expected are health benefits and increases in sales of sports and equestrian-related equipment. It is unlikely that any significant increases in tourism would occur as a result of the trail.

The National Park Service has performed studies on the impacts of recreation trails. In Seattle, a survey of real estate agents indicated that an average home near the Burke-Gilman Trail sells for approximately 6 percent more than a comparable home away from the trail. It is estimated that there are approximately 1,860 homes averaging approximately $125,000 in value in the Utah County communities along the proposed recreation trail. Assuming the same 6 percent increase documented in Seattle, home values in southern Utah County along the trail alignment would increase by $7,500. Thus, the local area could expect a total increase of approximately $14 million in property values over a 10-year period. Assuming property taxes of 1 percent, that increase would yield property tax collections of $140,000 per year. This would represent less than 1 percent of the total $81.9 million in tax revenue collected in the local area and, as such, would be below the 10 percent significance criterion.

Increases in sporting goods sales are expected for the area. Trail-related recreation would include pleasure walking, walking for health, jogging, bicycling, and horseback riding. According to the National Park Service, start-up costs range from $380 to $1,210 for biking, from $405 to $4,305 for horseback riding, and from $55 to $135 for jogging. Of these three activities, it is assumed that the trail would most likely stimulate new bicyclists. Assuming that 1 percent of the 6,700 persons living in the area take up bicycling, the trail could equate to approximately $25,000 to $85,000 in sales to the local economy from bicycle and bicycle-related purchases. This equates to less than 1 percent of personal income and, therefore, would not meet the 10 percent significance criterion. Economic impacts associated with the recreation trail would not be significant.

Municipal and Industrial (M&I) Systems. While the increased M&I water demand would serve both indoor and outdoor uses, the majority of the M&I water under the SFN System is expected to be utilized in secondary systems. Future indoor use may require additional capacity in water treatment plants.

The Salem Feasibility Study for Pressurized Irrigation was used as a reference to determine costs and impacts associated with the development of a secondary water system (see Appendix B, *Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template*). The study estimates that the total cost for installing the system in Salem would be approximately $3.7 million. Of the total cost, $2.4 million would be federally financed from the Credit Program or other conservation programs. The balance of $1.3 million would be funded by the City of Salem through loans from the Utah Department of Natural Resources.

Installation of the secondary system would conserve both culinary and irrigation water. The value of such water has been determined to be approximately $6.5 million over the 20-year life of the project. Therefore, the total savings for the City of Salem would be approximately $5.2 million.

Salem comprises approximately 5.3 percent of the total population of the communities that would install secondary M&I systems. Thus, the total savings to the local area would be nearly $100 million over the projected 20-year life, or approximately $5 million per year. This would represent less than 1 percent of the total local area income and falls below the 10 percent significance criterion.

3.12.6.3.3 Social Impacts. Social groups identified in Section 3.12.5.2.4 were represented at SFN System scoping meetings and have participated in the SFN System planning process. Input from long-term residents, irrigators and ranchers, and CUWCD customers was positive and reflected their desire to have the SFN System constructed in a timely manner. Environmental concerns raised by conservationists have been discussed in detail with representatives of these groups, and they have been involved throughout the environmental review process.

Construction of the Proposed Action would not cause a major lifestyle change to any of the groups identified as it would contribute to maintaining the predominant farming lifestyle in the local area. Conscious decisions to reduce water use, the implementation of secondary water systems, and the installation of water-saving devices would not be expected to severely conflict with the attitudes, beliefs, and values of a large percentage of those residing within the local area. It is anticipated that construction and operation of the Proposed Action would not bring about a severe disruption in the degree of cooperation between segments of the community, especially with the delivery of specified amounts of both M&I and agricultural water supplies. The recreation trail would also provide a means for individuals within the community to improve their health and experience an increase in property values. For these reasons, no significant adverse social or lifestyle impacts are expected to occur.

3.12.6.3.4 Mitigation. None.

3.12.6.3.5 Unavoidable Adverse Impacts. There would be no unavoidable adverse impacts to socioeconomics under the Proposed Action.

3.12.6.4 MCAPW-DFT Alternative

The following sections describe construction- and operation-related impacts resulting from the MCAPW-DFT Alternative. These impacts are summarized in Section 3.12.6.10.

3.12.6.4.1 Employment. Direct and indirect employment impacts on the regional area as a result of the MCAPW-DFT Alternative would be similar to those identified for the Proposed Action. These impacts are shown in Table 3.12-8.

3.12.6.4.2 Local Area

3.12.6.4.2.1 Farm Income. Impacts on local area farm income as a result of the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action.

3.12.6.4.2.2 Fiscal Impacts. Fiscal impacts to the local area as a result of the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action, with the exception of impacts associated with recreation. Under the MCAPW-DFT Alternative, the fiscal impact attributed to angler-use increases by 402 percent over baseline, and would result in an annual impact of $1,033,295. Also, no recreation trail would be constructed under this alternative; therefore, the fiscal impacts identified with a recreation trail in the Proposed Action would not be realized.

3.12.6.4.3 Social Impacts. Social impacts that would result from the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action.

3.12.6.4.4 Mitigation. None.

3.12.6.4.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts as a result of the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action.

3.12.6.5 MCAP Alternative

The following sections describe construction- and operation-related impacts resulting from the MCAP Alternative. These impacts are summarized in Section 3.12.6.10.

3.12.6.5.1 Employment. This section discusses both direct and indirect employment impacts on the regional area that would result from the construction of the MCAP Alternative. These impacts are shown in Tables 3.12-8 and 3.12-9.

3.12.6.5.1.1 Construction Employment. During the peak construction period, the MCAP Alternative would employ 60 people in the construction of the Main Conveyance Aqueduct, 15 people in the construction of the distribution and on-farm systems, and 85 people in the construction of Monks Hollow Dam. The total construction employment of 160 employees would be less than 1 percent of total baseline construction employment. This falls below the significance criterion of 10 percent and would therefore not be a significant impact.

Unlike the "Diamond Fork Tunnel Alternative," detailed construction employment estimates for Monks Hollow Dam were not developed as a part of this document. The construction of Monks Hollow Dam was considered in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984) in which construction employment estimates were not separated by system component. Contractor employment for the entire Diamond Fork System was estimated as 9.1 person-years per $1,000,000 of appropriations (in July 1980 dollars). This method of employment estimation is referenced from *Construction Impact for Each $1,000,000 of Appropriations* (USBR 1980).

This method was applied to a 1988 construction cost estimate of $54,676,000 for Monks Hollow Dam, as identified in the 1988 Definite Plan Report (USBR 1988a). After adjusting the cost estimate for inflation using the Gross Domestic Project Non-Defense Deflator, the construction cost in 1980 dollars is estimated as $37,426,146. Construction of the Diamond Fork System was scheduled to require 4 years. It is assumed that the construction of Monks Hollow Dam would also require 4 years and that appropriations (and employment) would be equally distributed over that 4-year period. Annual appropriations are then estimated as $9,356,286 (in 1980 dollars). Applying the USBR method of 9.1 person-years per $1,000,000 of appropriations leads to an estimated

work force requirement of 85 persons to construct Monks Hollow Dam over a 4-year construction period from the fourth quarter of 1999 through the first quarter of 2003.

3.12.6.5.1.2 Indirect Employment. Indirect employment as a result of construction employment is estimated at 335 jobs during the peak construction period. Total direct and indirect employment resulting from the MCAP Alternative would equal 495 jobs during the peak construction period. This represents less than 1 percent of all baseline employment in the regional area. Because this falls below the 10 percent significance criterion, this is not considered a significant impact.

3.12.6.5.1.3 Regional Area Personal Income (Construction Labor). Direct and indirect construction-related income impacts that would result from construction of the MCAP Alternative have been studied on a regional level and are presented in this section.

Employment Income. In the peak construction period, total construction personal income would be approximately $8,116,960, which is less than 1 percent of baseline construction income and below the 10 percent significance criterion. Therefore, no significant impacts would occur.

Indirect Income. Total indirect income from the MCAP Alternative would equal $11,955,480 in the peak construction period. Direct and indirect income would total $20,072,440 and represent an increase of less than 1 percent over the total baseline income of $26,918,651,000. Because this falls below the 10 percent significance criterion, there would be no significant impacts.

3.12.6.5.2 Local Area

3.12.6.5.2.1 Farm Income. Impacts on local area farm income as a result of the MCAP Alternative would be the same as those identified for the Proposed Action.

3.12.6.5.2.2 Fiscal Impacts. Fiscal impacts to the local area as a result of the MCAP Alternative would be the same as those identified for the Proposed Action, with the exception of impacts associated with increased angler-use. Under the MCAP Alternative, the fiscal impact attributed to angler-use would increase by 337 percent over the baseline, resulting in an annual increase of $865,544.

3.12.6.5.3 Social Impacts. Social impacts as a result of the MCAP Alternative would be the same as those identified for the Proposed Action.

3.12.6.5.4 Mitigation. None.

3.12.6.5.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts as a result of the MCAP Alternative would be the same as those identified for the Proposed Action.

3.12.6.6 MCAPW Alternative

The following sections describe construction- and operation-related impacts resulting from the MCAPW Alternative. These impacts are summarized in Section 3.12.6.10.

3.12.6.6.1 Employment. Direct and indirect employment impacts on the regional area as a result of the MCAPW Alternative would be the same as those identified for the MCAP Alternative.

3.12.6.6.2 Local Area

3.12.6.6.2.1 Farm Income. Impacts on local area farm income as a result of the MCAPW Alternative would be the same as those identified for the Proposed Action.

3.12.6.6.2.2 Fiscal Impacts. Fiscal impacts to the local area as a result of the MCAPW Alternative would be the same as those identified for the MCAPW-DFT Alternative, with the exception of impacts associated with angler-use. Under the MCAPW Alternative, the fiscal impact attributed to angler-use would increase by 334 percent over baseline, resulting in an annual increase of $857,537.

3.12.6.6.3 Social Impacts. Social impacts as a result of the MCAPW Alternative would be the same as those identified for the Proposed Action.

3.12.6.6.4 Mitigation. None.

3.12.6.6.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts as a result of the MCAPW Alternative would be the same as those identified for the Proposed Action.

3.12.6.7 MCATC Alternative

The following sections describe construction- and operation-related impacts resulting from the MCATC Alternative. These impacts are summarized in Section 3.12.6.10.

3.12.6.7.1 Employment. This section discusses both direct and indirect regional area employment impacts that would occur as a result of the construction of the MCATC Alternative. These impacts are shown in Tables 3.12-8 and 3.12-9.

3.12.6.7.1.1 Construction Employment. During the peak construction period, the MCATC Alternative would employ 90 people for the construction of the Main Conveyance Aqueduct, 75 people for the construction of the distribution and on-farm systems, and 85 people for the construction of Monks Hollow Dam. The total construction employment of 250 employees would be less than 1 percent of total baseline construction employment. This falls below the significance criterion of 10 percent and is therefore not considered a significant impact.

3.12.6.7.1.2 Indirect Employment. Indirect employment as a result of construction employment is estimated as 523 jobs during the peak construction period. Total direct and indirect employment resulting from the MCATC Alternative would equal 773 jobs during the peak construction period. This represents less than 1 percent of all baseline employment in the regional area. Because this is below the 10 percent significance criterion, this is not considered a significant impact.

3.12.6.7.1.3 Regional Area Personal Income (Construction Labor). Direct and indirect construction-related income impacts that would result from the construction of the MCATC Alternative have been studied on a regional level and are presented in this section.

Employment Income. In the peak construction period, total construction personal income is estimated at $12,682,750, which would be less than 1 percent of baseline construction income and would be below the 10 percent significance criterion; therefore, no significant impacts would occur.

Indirect Income. Total indirect income from the MCATC Alternative would equal $18,664,824 in the peak construction period. Direct and indirect income would total $31,347,574, which would be an increase of less than

1 percent over the total baseline income of $26,918,651,000. This falls below the 10 percent significance criterion, and thus, there would be no significant impacts.

3.12.6.7.2 Local Area

3.12.6.7.2.1 Farm Income. Impacts on local area farm income as a result of the MCATC Alternative are the same as those identified for the Proposed Action.

3.12.6.7.2.2 Fiscal Impacts. Fiscal impacts to the local area as a result of the MCATC Alternative would be the same as those identified for the MCAP Alternative, with the exception of impacts associated with the recreation trail. No recreation trail would be included under this alternative; therefore, the fiscal impacts identified with the recreation trail in the MCAP Alternative would not occur.

3.12.6.7.3 Social Impacts. Social impacts as a result of the MCATC Alternative would be the same as those identified for the Proposed Action.

3.12.6.7.4 Mitigation. None.

3.12.6.7.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts as a result of the MCATC Alternative would be the same as those identified for the Proposed Action.

3.12.6.8 MCAT Alternative

The following sections describe construction- and operation-related impacts that would result from the MCAT Alternative. These impacts are summarized in Section 3.12.6.10.

3.12.6.8.1 Employment. This section discusses both direct and indirect employment impacts on the regional area as a result of the construction of the MCAT Alternative. These impacts are shown in Tables 3.12-8 and 3.12-9.

3.12.6.8.1.1 Construction Employment. During the peak construction period, the MCAT Alternative would employ 90 people for the construction of the Main Conveyance Aqueduct, 45 people for the construction of the distribution and on-farm systems, and 85 people for the construction of Monks Hollow Dam. The total construction employment of 220 employees would be less than 1 percent of total baseline construction employment. This falls below the significance criterion of 10 percent and is therefore not considered a significant impact.

3.12.6.8.1.2 Indirect Employment. Indirect employment as a result of construction employment is estimated as 460 jobs during the peak construction period. Total direct and indirect employment resulting from the MCAT Alternative would equal 680 jobs during the peak construction period. This represents less than 1 percent of all baseline employment in the regional area. Because this falls below the 10 percent significance criterion, this is not considered a significant impact.

3.12.6.8.1.3 Regional Area Personal Income (Construction Labor). Direct and indirect construction-related income impacts that would result from the MCAT Alternative have been studied on a regional level and are presented in this section.

Employment Income. In the peak construction period, total construction personal income is estimated at $11,160,820, which would be less than 1 percent of baseline construction income and below the 10 percent significance criterion; therefore, no significant impacts would occur.

Indirect Income. Total indirect income from the MCAT Alternative would equal $16,416,480 in the peak construction period. Direct and indirect income would total $27,577,300 and represents an increase of less than 1 percent increase over the total baseline income of $26,918,651,000. Because this falls below the 10 percent significance criterion, there would be no significant impacts.

3.12.6.8.2 Local Area

3.12.6.8.2.1 Farm Income. Agricultural impacts on the local area as a result of the MCAT Alternative would be the same as those identified for the Proposed Action.

3.12.6.8.2.2 Fiscal Impacts. Fiscal impacts to the local area as a result of the MCAT Alternative would be the same as those identified for the MCAPW Alternative.

3.12.6.8.3 Social Impacts. Social impacts as a result of the MCAT Alternative would be the same as those identified for the Proposed Action.

3.12.6.8.4 Mitigation. None.

3.12.6.8.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts as a result of the MCAT Alternative would be the same as those identified for the Proposed Action.

3.12.6.9 No Action Alternative

The No Action Alternative would not achieve the same levels of social and economic benefits that would be achieved under the Proposed Action or the other alternatives. However, there would be a slight increase in agricultural productivity as a result of 3,500 acre-feet of Bonneville Unit water that would be available to agricultural lands in southern Utah County with a slight associated economic benefit. Additionally, there would be a fiscal increase of $778,466 per year associated with increases in angler use. Locally developed M&I water delivery systems would have the same impacts as described under the Proposed Action.

Construction of the Three Forks Dam would result in an influx of construction workers and the creation of 441 jobs during the construction period. Under the No Action Alternative, most of the agricultural producers in southern Utah and eastern Juab Counties would continue to be unable to meet demands for full season water supplies. Shortages in supply to agriculture would continue to worsen because of the projected increases in water demands and the priority of municipal and industrial users. As a result, the current impacts of insufficient water supplies on agricultural production would be compounded over time. Productivity levels of prime farmlands now limited only by insufficient water supplies would also continue to be diminished. A more thorough description of agricultural impacts is provided in Section 3.9.

3.12.6.10 Summary of Impacts

A summary of impacts for the Proposed Action and each of the alternatives is shown in Table 3.12-14. No significant impacts occur under the Proposed Action or any alternatives. Under the No Action Alternative, no impacts would occur, except to recreation, and that impact would not be significant.

3.12.6.11 Cumulative Impacts

Section 1.8 identifies projects to be considered in the cumulative impact analysis. The projects identified would not have a significant impact on social and economic resources within the impact area of influence.

Table 3.12-14
Summary of Impacts for Socioeconomic Resources

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Resource	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
SFN System				
Direct and indirect employment	Employment increase of 325 jobs.	Not significant	None	Not significant
Direct and indirect personal income	Total income increase of less than 1 percent.	Not significant	None	Not significant
Recreational impacts	Angler-use: Fiscal impact of $1,035,926 per year.	Not significant	None	Not significant
	Recreation trail: Potential increase of $7,500 in property value for properties close to the trail, resulting in potential increases in property tax collections of $140,000 per year.	Not significant	None	Not significant
Social environment	Input from various social groups is positive and reflects a desire to have the system constructed. Concerns raised by conservationists have been discussed in detail with interested parties.	Not significant	None. See Sections 3.4 and 3.5 (Wetlands and Wildlife) for mitigation relating to concerns raised by conservationists.	Not significant
Local Development				
Distribution Systems				
M&I distribution systems	Installation would result in an annual cost savings of $5 million per year.	Not significant	None	Not significant
On-Farm Systems				
Farm income	Increase of 54 percent.	Not significant	None	Not significant
MCAPW-DFT Alternative				
SFN System				
Direct and indirect employment	Same as Proposed Action.			
Direct and indirect personal income	Same as Proposed Action.			
Recreational impacts	Angler-use: Fiscal impact of $1,033,275 per year.	Not significant	None	Not significant
Social environment	Same as Proposed Action.			
Local Development				
Same as Proposed Action.				

Table 3.12-14
Summary of Impacts for Socioeconomic Resources

Page 2 of 3

Resource	Impact	Significance	Mitigation	Significance After Mitigation
MCAP Alternative				
SFN System				
Direct and indirect employment	Employment increase of 495 jobs.	Not significant	None	Not significant
Direct and indirect personal income	Total income increase of less than 1 percent.	Not significant	None	Not significant
Recreational impacts	Angler-use: Fiscal impact of $865,544 per year.	Not significant	None	Not significant
	Recreation trail: Same as Proposed Action.	Not significant	None	Not significant
Social environment	Same as Proposed Action.			
Local Development - Same as Proposed Action				
MCAPW Alternative				
SFN System				
Direct and indirect employment	Same as MCAP Alternative.			
Direct and indirect personal income	Same as MCAP Alternative.			
Recreational impacts	Angler-use: Fiscal impact of $857,537 per year.	Not significant	None	Not significant
Social environment	Same as Proposed Action.			
Local Development - Same as Proposed Action				
MCATC Alternative				
SFN System				
Direct and indirect employment	Employment increase of 773 jobs.	Not significant	None	Not significant
Direct and indirect personal income	Total income increase of less than 1 percent.	Not significant	None	Not significant
Recreational impacts	Angler-use: Fiscal impact of $865,544 per year.	Not significant	None	Not significant
Social environment	Same as Proposed Action.			
Local Development - Same as Proposed Action				

Table 3.12-14
Summary of Impacts for Socioeconomic Resources

Page 3 of 3

Resource	Impact	Significance	Mitigation	Significance After Mitigation
MCAT Alternative				
SFN System				
Direct and indirect employment	Employment increase of 680 jobs.	Not significant	None	Not significant
Direct and indirect personal income	Total income increase of less than 1 percent.	Not significant	None	Not significant
Recreational impacts	Angler-use: Fiscal impact of $857,537 per year.	Not significant	None	Not significant
Social environment	Same as Proposed Action.			
Local Development - Same as Proposed Action				
No Action Alternative				
SFN System				
Direct and indirect employment	Employment increase of 441 jobs.	Not significant	None	Not significant
Recreational impacts	Angler-use: Fiscal impact of $778,446 per year.	Not significant	None	Not significant
M&I distribution systems	Installation would result in an annual cost savings of $5 million.	Not significant	None	Not significant

Note: This summary includes both construction- and operation-related impacts.

3.13 Cultural Resources

3.13.1 Introduction

This section provides a description of recorded cultural and paleontological resources that could be affected by the construction, operation, and maintenance of the SFN System and related actions and discusses the potential impacts to these resources. Intensive archaeological or paleontological ground surveys have not yet been conducted (with the exception of the High Line Canal, four distribution lines, and the West Mona Pumping Plant). Cultural resources include all historic and prehistoric remains associated with human occupation of an area. Paleontological resources are fossilized remains of plants and animals from former geologic periods.

3.13.2 Issues Eliminated from Further Analysis

No issues related to potential impacts on cultural or paleontological resources have been eliminated.

3.13.3 Issues Addressed in the Impact Analysis

No issues or concerns on the subject of cultural or paleontological resources were raised by the public or by federal, State, or local agencies during the scoping process. However, potential adverse impacts (e.g., disturbance or destruction of resources) to cultural or paleontological resources were considered in this analysis.

3.13.4 Description of Impact Area of Influence

The impact area of influence for cultural and paleontological resources includes any area directly or indirectly disturbed by construction activities (including the distribution and on-farm facilities) described in Chapter 1 and those areas affected by fluctuating surface water levels.

3.13.5 Affected Environment

The affected environment includes the recorded prehistoric and historic sites that could be affected by the construction and operation of the SFN System and local development.

3.13.5.1 Proposed Action

This section describes the cultural and paleontological resources that could be affected by the Proposed Action. Each feature of the SFN System and local development systems that could affect a known cultural or paleontological resource is listed, followed by a description of the affected resource. In addition, this section identifies cultural resources near Mona Reservoir that could be affected by the operation of the Proposed Action.

There are no known paleontological resources that could be affected by the Proposed Action. Therefore, this section discusses only cultural resources. However, the proposed Spanish Fork Pipeline, Snell Canyon Pipeline, and distribution systems would pass across several geologic formations sensitive for trace fossils, vertebrate fossils, and invertebrate fossils.

3.13.5.1.1 "Diamond Fork Tunnel Alternative." No archaeological surveys have been conducted within the affected environment of the "Diamond Fork Tunnel Alternative" facilities to be constructed under the Proposed Action.

3.13.5.1.2 Main Conveyance Aqueduct and Associated Facilities. The recorded prehistoric and historic sites located within the disturbance area that would be associated with the Main Conveyance Aqueduct and associated

features (i.e., pipeline and turnouts, regulating ponds, equalization reservoirs, and Main Conveyance Reservoir) are summarized in Table 3.13-1. Land disturbance by project feature for the Proposed Action is listed in Chapter 1 and shown in Table 1-18.

Table 3.13-1
Summary of Prehistoric and Historic Sites
Within the Main Conveyance Aqueduct and Associated Facilities Land Disturbance Area

Site Number	Site Type	Time Period	Cultural Affiliation	NRHP Eligibility
46UT362	Abandoned Resort	Historic	Euro-American	Undetermined
42UT470 (Strawberry Power Canal)	Canal	Historic	Euro-American	Eligible
42UT473 (High Line Canal)	Canal	Historic	Euro-American	Eligible
42JB109-113	Mound	Prehistoric	Fremont	Undetermined
42JB498	Mound	Prehistoric	Fremont	Undetermined
Irrigation Canal	Canal	Historic	Euro-American	Undetermined

Site 42UT362 is a concrete foundation that is all that remains of the abandoned resort at Castilla Warm Springs. Site 42UT470 is the Strawberry Power Canal, which is part of the SVP and, as such, is eligible for listing on the National Register of Historic Places (NRHP). The SVP is historically significant because it was the first project built by the U.S. Reclamation Service in Utah and had a major impact on the way water has been developed and distributed in Utah (Merrill et al. 1982). The SVP and its features were mitigated in 1982 (Merrill et al. 1982) with a report that documented the channel's significance and history and provided maps and historical and contemporary photos.

The High Line Canal (42UT473, Historic American Engineering Record [HAER] No. UT-26P) begins at the end of the Strawberry Power Canal, 3 miles southeast of Spanish Fork, and extends in a southwesterly direction for 17.5 miles, ending 2 miles northwest of Santaquin. It is earth-lined in some sections and cement-lined in others. Construction of the canal began in 1915 and was turned over for operation to the SWUA on April 24, 1916. It is a feature of the SVP and, as such, is eligible for listing on the NRHP.

In 1975, Patrick Hogan of the University of Utah recorded several prehistoric Fremont mounds (42JB109-113) associated with the larger Nephi Mound group (42JB2) (i.e., a collection of Fremont residential structures) in fields just west of the north Nephi I-15 interchange. The upper portions of these mounds have been disturbed by plowing, and many have likely been disturbed by looting over the last century. Intact deposits likely remain in and around most of the mounds. Hogan made no significance recommendation, and eligibility remains undetermined.

Matheny (1977) tested Site 42JB498, a Fremont mound (subsurface structure), which is located in the Nephi Industrial Park site. Although not directly associated with the Nephi Mounds, this site is also Fremont in origin. Excavations revealed a single pit structure containing ceramic and lithic artifacts and ground stone materials.

The irrigation canal west of the railroad tracks in Nephi qualifies as an historical site, but has not been recorded. The canal probably had its origins in the 1880s; a casual reconnaissance of the area located a cement culvert dated 1917.

The recorded prehistoric and historic sites located within the West Mona Pumping Plant and power line land disturbance area are summarized in Table 3.13-2. The West Mona Pumping Plant would be located within or near two prehistoric sites. Site 42JB139 is a large lithic scatter of undetermined eligibility. Although the site boundaries were originally placed on the Mona Reservoir beach area just east of the proposed pumping plant, a recent survey by Talbot (1995) located no artifactual remains in the area of the proposed pumping plant. Site 42JB504, which is located within the area of the proposed pumping plant, is a small and highly disturbed lithic scatter that does not meet NRHP criteria for eligibility. The Mona power line would pass through or very near two known prehistoric campsites (42JB68 and 42JB72) of undetermined eligibility along Goshen Canyon Road. In addition, the power line would pass near an historic farmstead (42JB338) possibly built on top of Fremont mounds. Site 42JB338 has been designated as eligible for listing on the NRHP.

Table 3.13-2
Summary of Prehistoric and Historic Sites Within the West Mona Facilities Land Disturbance Area

Site Number	Site Type	Time Period	Cultural Affiliation	NRHP Eligibility
42JB139	Lithic Scatter	Prehistoric	Fremont	Undetermined
42JB68	Campsite	Prehistoric	Unknown	Undetermined
42JB338	Farmstead/ Possible Mound	Historic/ Prehistoric	Euro-American/ Fremont	Eligible
42JB504	Lithic Scatter	Prehistoric	Unknown	Not eligible
42JB72	Campsite	Prehistoric	Unknown	Undetermined

The recorded prehistoric and historic sites that could be affected by operational changes to Mona Reservoir are summarized in Table 3.13-3.

3.13.5.1.3 Related Actions (Local Development)

3.13.5.1.3.1 Irrigation Distribution Systems. The recorded prehistoric and historic sites associated with the distribution system, which are described below, are summarized in Table 3.13-4.

3.13.5.1.3.2 On-Farm Systems. Irrigation systems that may be affected by changes associated with the Proposed Action include the Mona City Irrigation System and the Nephi Irrigation System. The Mona City Irrigation System began operating sometime in the 1880s along the East Bench, drawing water from Willow Creek. Irrigation in the area of Nephi City originated in the 1850s with the founding of the settlement. The Nephi Irrigation Company was formed in 1879. Portions of this canal system probably date from between 1850 and 1879. During a casual reconnaissance of the area, one culvert dated 1917 was noted.

The Mapleton Lateral (42UT471, HAER No. 26M) is a distribution lateral that draws water from the Strawberry Power Canal through the Mapleton Siphon (42UT472) across the Spanish Fork River and under the Denver and Rio Grande Western Railroad tracks. A canal then carries the water across the highest portion of Mapleton Bench and eventually empties into the East Bench Canal. Construction of this canal was completed in the fall of 1918. This lateral was also included in the mitigation for the SVP enhancements completed in 1982 (Merrill et al. 1982).

Table 3.13-3
Summary of Prehistoric and Historic Sites That Could Be Affected by Operational Changes to Mona Reservoir

Site Number	Site Type	Time Period	Cultural Affiliation	NRHP Eligibility
42JB138	Lithic Scatter	Prehistoric	Fremont	Undetermined
42JB139	Lithic Scatter	Prehistoric	Fremont	Undetermined
42JB140	Campsite	Prehistoric	Unknown	Undetermined
42JB141	Campsite	Prehistoric	Unknown	Undetermined
42JB142	Lithic Scatter	Prehistoric	Fremont	Undetermined
42JB356	Campsite	Prehistoric	Unknown	Eligible
42JB365	Lithic Scatter	Prehistoric	Fremont	Not eligible
42JB367	Lithic Scatter	Prehistoric	Unknown	Not eligible
42JB338	Farmstead/Possible Mound	Historic/ Prehistoric	Euro-American/ Fremont	Eligible

Table 3.13-4
Summary of Prehistoric and Historic Sites Associated with Distribution Systems

Site Number	Site Type	Time Period	Cultural Affiliation	NRHP Eligibility
42UT471 (Mapleton Lateral)	Canal	Historic	Euro-American	Eligible
42UT473 (Lateral 20)	Canal	Historic	Euro-American	Eligible
Salem Canal	Canal	Historic	Euro-American	Not eligible
South Field Canal	Canal	Historic	Euro-American	Eligible
42JB68, 42JB72	Campsites	Prehistoric	Unknown	Undetermined
42JB338	Farmstead	Historic	Euro-American	Eligible

Lateral 20 (HAER No. UT-26Q) is a distribution lateral of the High Line Canal (42UT473, HAER No. UT-26P). It leaves the High Line Canal just south of the city of Payson and loops west and then north around the city. This lateral was constructed concurrently with the High Line Canal and completed in 1916. As part of the High Line Canal, Lateral 20 was included in the mitigation report for the SVP (Merrill et al. 1982).

The Salem Canal was built between 1865 and 1867, when irrigators from Salem and Payson negotiated rights to a portion of the water from the Spanish Fork River (Merrill et al. 1982). The Salem Canal Company was formally incorporated in 1878 (Huff 1947).

The South Field Canal had its origins in the 1850s. The early Mormon Church encouraged the formation of small communities with large farm "fields" surrounding the residential community. The Spanish Fork city charter included the power to control all the water of the Spanish Fork River (Warner 1930), and the city in turn granted

charters to the irrigators in the various "fields" to form companies to govern the uses of land and water in their districts (Merrill et al. 1982). The South Field Irrigation Company was formed in 1859.

The West Mona distribution pipeline would pass through or very near the previously discussed known prehistoric campsites (42JB68 and 42JB72) of undetermined eligibility and the historic farmstead (42JB338).

The Currant Creek distribution pipeline would replace the Currant Creek Irrigation Company's existing diversion pipeline/canal located below (downstream of) Mona Reservoir. The existing 38 cfs pipeline begins at the Currant Creek diversion structure (approximately 1.9 miles below Mona Dam on Currant Creek). The diversion pipeline/canal would be left in place. A pump house is located approximately 1,000 feet downstream from the diversion point along the pipeline/canal. No modifications to this structure are proposed. No information on the history or significance of the pipeline/canal is currently available; however, it is possible that these structures would be eligible for the NRHP.

The recorded prehistoric and historic sites associated with the on-farm system are summarized in Table 3.13-5. The sites in the vicinity of Mona Reservoir were recorded as a result of several survey projects, as well as by members of the Utah Statewide Archaeological Society, which recorded sites as part of its certification program. The likelihood for additional sites to be encountered in this area is high.

Table 3.13-5
Summary of Prehistoric and Historic Sites Associated with On-Farm Systems
(Proposed Action and MCATC and MCAT Alternatives)

Site Number	Site Type	Time Period	Cultural Affiliation	NRHP Eligibility
42JB141	Campsite	Prehistoric	Unknown	Undetermined
42JB142	Lithic Scatter	Prehistoric	Fremont	Undetermined
42JB143	Lithic Scatter	Prehistoric	Unknown	Undetermined
42JB144	Lithic Scatter	Prehistoric	Unknown	Undetermined
42JB72	Campsite	Prehistoric	Unknown	Undetermined
42JB68	Campsite	Prehistoric	Unknown	Undetermined
Mona City Irrigation System	Irrigation System	Historic	Euro-American	Undetermined
Nephi Irrigation System	Irrigation System	Historic	Euro-American	Undetermined

3.13.5.1.3.3 M&I Water Distribution System. As described in Section 1.9.2.1, it is anticipated that some water distribution facilities would be modified and/or constructed by communities receiving M&I water. However, since no specific plans for the development of secondary systems are known, it is not possible to determine where or if any cultural sites are present. It is possible that some cultural resources may be present.

3.13.5.2 MCAPW-DFT Alternative

The affected environment for cultural and paleontological resources for the MCAPW-DFT Alternative would be the same as that described for the Proposed Action.

3.13.5.3 MCAP Alternative

The affected environment for cultural and paleontological resources for the MCAP Alternative would be the similar to that described for the Proposed Action; however, under the MCAP Alternative, Monks Hollow Dam and Reservoir would be constructed as part of the Diamond Fork System instead of the "Diamond Fork Tunnel Alternative." As discussed in the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984), Class III intensive cultural resource surveys were completed for approximately 90 percent of the Diamond Fork System for all alternatives, and no National Register-listed or eligible prehistoric or historic cultural resources were identified. However, material source areas, access roads, and contractor staging areas would require Class III surveys.

3.13.5.4 MCAPW Alternative

The affected environment for cultural and paleontological resources for the MCAPW Alternative would be the same as that described for the MCAP Alternative.

3.13.5.5 MCATC Alternative

The affected environment for cultural resources for the MCATC Alternative would be similar to that described for the MCAP Alternative. There are no known paleontological resources that could be affected by the MCATC Alternative, but Loafer Mountain Tunnel, Dry Mountain Tunnel, and the distribution systems would pass across several geologic formations known to be sensitive for trace fossils, vertebrate fossils, and invertebrate fossils.

3.13.5.6 MCAT Alternative

The affected environment would be the same as that described for the MCATC Alternative.

3.13.5.7 No Action Alternative

The affected environment for the No Action Alternative would be limited to areas along the Spanish Fork River below Diamond Fork Creek and at the Three Forks Dam site. Only one cultural site (46UT362) is located along the portion of the Spanish Fork River that would be affected by the No Action Alternative. The eligibility of that site for NRHP listing has not been determined. No archaeological surveys have been conducted within the affected environment of the Three Forks Dam and Reservoir areas. There are no known paleontological resources that would be affected by the No Action Alternative.

3.13.6 Impact Analysis

3.13.6.1 Significance Criteria

3.13.6.1.1 Cultural Resources. For this evaluation, the significance criteria for impacts on cultural resources are based on whether the cultural resource has properties that meet the criteria for inclusion in the NRHP (i.e., the cultural resource is eligible for inclusion) or has already been listed in the NRHP. Ultimately, significance (or eligibility) would be determined by the lead federal agency in consultation with the State Historic Preservation Office (SHPO) and the Keeper of the NRHP. Effect determinations and treatment planning are conducted by the lead federal agency in consultation with the SHPO and the Advisory Council on Historic Preservation (ACHP). However, for this report, determination of whether an effect resulting from the SFN System or distribution systems causes an adverse impact is based on whether the resource affected is considered potentially eligible or is already listed in the NRHP. If the eligibility of a site is undetermined, it is assumed for the purpose of this analysis that the site is eligible. Impacts to cultural resources are considered significant if either of the following were to occur:

- Disturbance to or alteration of site surface and/or features; excavation, burial, or inundation of any cultural resource in, or eligible for nomination to, the NRHP or the Utah Register
- Alteration to surrounding topographic or cultural features in such a way as to adversely affect the feeling, setting, or association of a significant property

3.13.6.1.2 Paleontologic Resources. The significance criterion used for paleontologic resources is identified below.

- Adverse impact on paleontologic resources determined to be Class I (Critical), Class II (Significant), or Class III (Important) paleontologically sensitive fossil localities or a Type 1 paleontologically sensitive geologic formation

A site in question would need to be evaluated in consultation from the State Paleontologist. For Class I sites, no action would be allowed that would damage or alter the contextual relationships of the fossil materials. Type 1 formations within the project area would also be evaluated by the State Paleontologist or, on his recommendation, a professional paleontologist.

3.13.6.2 Potential Impacts Eliminated from Further Analysis

No potential impacts to cultural or paleontological resources were eliminated from further analysis.

3.13.6.3 Proposed Action

The following sections describe construction- and operation-related impacts that would result from the Proposed Action. These impacts are summarized in Section 3.13.6.10.

3.13.6.3.1 Cultural Resources. This section identifies potential impacts to known cultural resources that would result from the construction and operation of the Proposed Action. However, it should be noted that there have been very few archaeological surveys conducted within the affected environment of the Proposed Action, and it must be presumed that some potential exists for encountering new sites could be located where ground-disturbing activities would occur.

3.13.6.3.1.1 "Diamond Fork Tunnel Alternative." As mentioned previously in Section 3.13.5.1.1, no archeological surveys were conducted for the Tanner Ridge Tunnel, Diamond Fork Siphon, Red Mountain Tunnel, Round Mountain Pipeline, or construction staging areas.

3.13.6.3.1.2 Main Conveyance Aqueduct and Associated Facilities. As a result of the Proposed Action, construction activities (e.g., clearing, grading) associated with the Spanish Fork Pipeline segment of the Main Conveyance Aqueduct would damage two historic sites: 42UT362 (Castilla Warm Springs) and 42UT470 (the Strawberry Power Canal). Impacts to these sites would be significant because the eligibility of Site 42UT362 is undetermined (sites of undetermined eligibility are assumed to be eligible for listing on the NRHP) and Site 42UT470 is eligible for listing on the NRHP.

As a result of the Proposed Action, the High Line Canal would be replaced by the Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct. The replacement of the High Line Canal would be a significant adverse impact because the High Line Canal is eligible for listing on the NRHP.

Construction activities associated with the Nephi Pipeline segment of the Main Conveyance Aqueduct could potentially damage two prehistoric sites designated 42JB109-113 and 42JB498. This would be a significant adverse impact because the eligibility of both sites is undetermined (sites of undetermined eligibility are assumed

to be eligible for listing on the NRHP). Construction of the Nephi Pipeline would eliminate sections of the irrigation canal west of the railroad track in Nephi. The elimination of sections of the irrigation canal would be a significant adverse impact because the eligibility of the canal for listing on the NRHP is undetermined.

Construction activities associated with the West Mona Pumping Plant would significantly damage a prehistoric site (42JB504). This site is not eligible for listing on the NRHP; therefore, the impact would not be significant. Construction activities associated with the West Mona power line could damage two recorded prehistoric sites (42JB68 and 42JB72) and one recorded historic/prehistoric site (42JB338). Impacts to these sites would be significant because Sites 42JB68 and 42JB72 are of undetermined eligibility and Site 42JB338 is eligible for listing on the NRHP.

Operational changes to Mona Reservoir would stabilize water levels, thereby reducing potential wave damage to eight prehistoric sites (42JB138, 42JB139, 42JB140, 42JB141, 42JB142, 42JB356, 42JB365, and 42JB367) and one historic/prehistoric site (42JB338).

3.13.6.3.1.3 Related Actions (Local Development). The following sections describe construction- and operation-related impacts of local development that would occur as a result of the Proposed Action.

Irrigation Distribution System. As a result of the Proposed Action, 6.6 miles of the Mapleton Lateral, 8.5 miles of Lateral 20, and 2.9 miles of the South Field Canal would be eliminated. This would be a significant adverse impact because these canals are eligible for listing on the NRHP. In addition, 6.5 miles of the Salem Canal would be eliminated; this would not be a significant impact because the Salem Canal is not eligible for listing on the NRHP.

On-Farm System. Construction activities associated with on-farm system improvements (replacing existing open canals with pipeline) could potentially damage six prehistoric sites (42JB141, 42JB142, 42JB143, 42JB144, 42JB72, and 42JB68) and two historic sites (the Mona City and Nephi Irrigation Systems). Any damage to these sites would be significant because their eligibility is undetermined.

M&I Water Distribution System. Currently, no preliminary plans exist for the construction of the M&I water systems. However, the construction of these systems could potentially affect cultural resources.

3.13.6.3.2 Paleontological Resources. Although there are no known paleontological resources that could be affected by the Proposed Action, certain project features (the Spanish Fork Pipeline, Snell Canyon Pipeline, and the distribution systems) pass across geologic formations sensitive for trace fossils, vertebrate fossils, and invertebrate fossils. Therefore, it must be presumed that some potential for encountering new sites is likely anywhere ground-disturbing activities would occur.

3.13.6.3.3 Mitigation. Prior to construction, a Class III survey of the impact area of influence would be required. Areas within the impact area of influence that are covered by existing Class III surveys would not require new surveys.

Adverse effects upon NRHP-eligible or NRHP-listed sites must be mitigated in consultation with the Utah SHPO and ACHP. Avoidance is the alternative preferred by the SHPO and ACHP. However, where avoidance would not be possible, mitigation of archaeological sites would generally consist of data collection through excavation. Mitigation of historic sites consists of documentation meeting the standards of the Historic American Building Survey/Historic American Engineering Record (HABS/HAER) program of the National Park Service. Before mitigation of any site, exact measures and procedures would be submitted to the SHPO and ACHP for approval.

The High Line Canal, Lateral 20, and Mapleton Canal have been previously examined in detail by Merrill et al. (1982), with the finding that all were historically significant and eligible for the NRHP. Subsequently, each canal

and lateral was documented by completion of HAER-level recordation. Consequently, the adverse effect from the Proposed Action or alternatives is considered to be properly and adequately mitigated, and no further mitigation would be required for these sites. The alignment for the Currant Creek distribution pipeline has not been previously examined. A potential exists for cultural sites to be found along the pipeline alignment or for the adjacent existing pipeline/canal to be considered potentially eligible for the NRHP. A qualified archaeologist would determine the potential for sites to be present and their eligibility. Avoidance of any sites would be the preferred mitigation. If that is not feasible, mitigation measures should be determined through data collection.

Mitigation for paleontological resources would depend upon the sensitivity level of each site. No action would be allowed that would damage the fossil resource or alter the contextual relationships of fossil materials of Class I (Critical) localities. For Class II (Significant) localities, approved mitigation could include total salvage or could be limited to a statistically valid sample of all forms present. Class III (Important) localities could be mitigated by obtaining a statistically valid sample. In every case, consultation with the State Paleontologist would precede mitigation.

3.13.6.3.4 Unavoidable Adverse Impacts. There would not be any potential adverse impacts to cultural resources that could not be mitigated.

3.13.6.4 MCAPW-DFT Alternative

Impacts and mitigation for the MCAPW-DFT Alternative would be the same as those described for the Proposed Action. However, the Main Conveyance Aqueduct would not replace sections of the High Line Canal, but would cross the High Line Canal twice.

3.13.6.5 MCAP Alternative

Impacts and mitigation for the MCAP Alternative would be similar to that described for the Proposed Action. However, Monks Hollow Dam and Reservoir would be constructed instead of the "Diamond Fork Tunnel Alternative;" therefore, potential sites within the Diamond Fork drainage could differ.

3.13.6.6 MCAPW Alternative

Impacts and mitigation for the MCAPW Alternative would be the same as those described for the MCAP Alternative; however, the High Line Canal would not be removed from service. The Main Conveyance Aqueduct would not replace sections of the High Line Canal, but would cross the canal twice.

3.13.6.7 MCATC Alternative

Impacts and mitigation for the MCATC Alternative would be similar to those described for the Proposed Action; however, the alignment of the Main Conveyance Aqueduct would differ in southern Utah County and potential sites could differ.

3.13.6.8 MCAT Alternative

Impacts for the MCAT Alternative would be the same as those described for the MCATC Alternative, except as noted below.

3.13.6.8.1 Main Conveyance Aqueduct and Associated Facilities. The High Line Canal and the Strawberry Power Canal would not be affected as a result of the MCAT Alternative.

3.13.6.8.2 Related Actions (Local Development). The Mapleton-Springville Lateral, Salem Canal, South Field Canal, and Lateral 20 would not be affected as a result of the MCAT Alternative.

3.13.6.9 No Action Alternative

There would be no effects on known cultural resources resulting from the No Action Alternative. Increased flow in the Spanish Fork River would not adversely affect an existing cultural site (42U7362, Castilla Warm Springs). Locally developed M&I distribution systems would result in the same potential impacts identified under the Proposed Action.

3.13.6.9.1 Mitigation. A Class III survey of the Three Forks Dam and Reservoir site and all areas of M&I system construction would be required prior to construction in those areas.

3.13.6.10 Summary of Impacts

Potential impacts of the Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives are summarized in Table 3.13-6.

Table 3.13-6
Summary of Impacts for Cultural Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, and MCAT Alternatives				
Unknown Cultural Sites	Construction activities could damage unknown sites.	Significant	Prior to construction, a Class III survey of the impact area of influence would be required. Avoidance is the preferred mitigation by SHPO and ACHP. Where avoidance is not possible, mitigation of archaeological sites generally consists of data collection through excavation.	Not significant
46UT362, 42UT470 42JB109-113, 42JB498 42JB68, 42JB72, 42JB338	Construction activities would damage the site.	Significant		Not significant
42JB504	Construction activities would damage the site.	Not significant		Not significant
Unknown Paleontological Sites	Construction activities could damage unknown sites.	Significant		Not significant
Irrigation Canal in Nephi	Sections of the irrigation canal would be eliminated.	Significant	HAER-level recordation has been completed. No further mitigation is required.	Not significant
42UT473 High Line Canal	The High Line Canal would be replaced.[a]	Significant		Not significant
42JB138, 42JB139, 42JB140, 42JB141, 42JB142, 42JB338, 42JB356, 42JB365, 42JB367	Operation of the SFN System could reduce wave damage to sites near Mona Reservoir.	Not significant (beneficial)	None	Not significant (beneficial)

Table 3.13-6
Summary of Impacts for Cultural Resources

Page 2 of 2

Resources	Impact	Significance	Mitigation	Significance After Mitigation
Local Development				
42UT471 Mapleton Lateral[b]	6.6 miles of the lateral would be eliminated.	Significant	HAER-level recordation has been completed. No further mitigation is required.	Not significant
42UT473 Lateral 20[b]	8.5 miles of the lateral would be eliminated.	Significant		Not significant
Currant Creek Distribution Pipeline	Construction could adversely affect cultural sites along Currant Creek and existing pipeline/canal.	Potentially significant if sites are present	Avoidance is the preferred mitigation by SHPO and ACHP. Where avoidance is not possible, mitigation of archaeological sites generally consists of data collection through excavation.	Not significant
South Field Canal[b]	2.9 miles of the canal would be eliminated.	Significant	Documentation and historical research of the South Field Canal.	Not significant
Salem Canal[b]	6.5 miles of the canal would be eliminated.	Not significant	None	Not significant
On-Farm Systems				
42JB68, 42JB141, 42JB142, 42JB143, 42JB144, Mona City Irrigation System, Nephi City Irrigation System	Construction activities could damage the site.	Significant	Avoidance is the preferred mitigation by SHPO and ACHP. Where avoidance is not possible, mitigation of archaeological sites generally consists of data collection through excavation.	Not significant
No Action Alternative				
Unknown Cultural Sites	Construction activities could damage unknown sites.	Significant	Prior to construction, a Class III survey of the impact area of influence would be required. Avoidance is the preferred mitigation by SHPO and ACHP. Where avoidance is not possible, mitigation of archaeological sites generally consists of data collection through excavation.	Not significant

[a]The High Line Canal would not be removed under the MCAPW-DFT, MCAPW, and MCAT Alternatives.
[b]These canals would not be removed under the MCAPW-DFT, MCAPW, and MCAT Alternatives.

3.13.6.11 Cumulative Impacts

Section 1.8 identifies projects to be considered in the cumulative impact analysis. The projects identified would not affect the same cultural resources that occur within the SFN System impact area of influence. In addition, all potential cultural impacts under the Proposed Action and alternatives have been, or would be, fully mitigated. Therefore, there would be no significant cumulative impacts on cultural resources.

3.14 Visual Resources

3.14.1 Introduction

This section addresses potential impacts to visual resources that would result from the construction, operation, and maintenance of the SFN System and the related actions (local development). The focus of this analysis is on 1) potential short-term impacts (less than 3 years) and 2) potential long-term impacts (more than 3 years) to visual resources.

3.14.2 Issues Eliminated from Further Analysis

No issues were eliminated from further analysis.

3.14.3 Issues Addressed in the Impact Analysis

The following issues were identified during the scoping process and are analyzed in the impact analysis:

- Potential adverse impacts to the visual quality of the area
- Potential impacts to views as seen from scenic highways

3.14.4 Description of Impact Area of Influence

The geographic area within which visual resources may be affected by the construction, operation, and maintenance of the SFN System and the related actions (local development) includes all locations from which these facilities could be viewed. Visual settings in which the SFN System would be located are divided into four general areas: the Diamond Fork Creek drainage upstream from Monks Hollow, Spanish Fork Canyon, the southeastern end of Utah Valley, and northeastern Juab Valley. These areas are located within southern Utah and eastern Juab Counties.

Certain facilities would be located within and adjacent to the Uinta National Forest. The USFS has detailed guidelines concerning visual impacts associated with development projects located within national forests. Therefore, USFS lands are discussed separately from other lands in this analysis.

3.14.5 Affected Environment

Four areas in Diamond Fork Canyon and its tributary canyons (i.e., Diamond Fork drainage) would be affected by the construction of the "Diamond Fork Tunnel Alternative" (see Map 1-3). These areas are located on Sixth Water Creek, in upper Diamond Fork Canyon (upstream of Three Forks), in Red Hollow, and in Diamond Fork Canyon near Monks Hollow. These four areas would be affected visually by the Proposed Action and the MCAPW-DFT Alternative. The other action alternatives (i.e., MCAP, MCAPW, MCATC, and MCAT Alternatives) would not affect these four areas because they would not include the "Diamond Fork Tunnel Alternative." Instead, they would be accompanied by the construction of Monks Hollow Dam and Reservoir, whose visual impacts would be limited to Diamond Fork Canyon in the vicinity of Monks Hollow for a distance of approximately 2.5 miles upstream. The No Action Alternative would be accompanied by the construction of Three Forks Dam and Reservoir, whose visual impacts would be limited to Diamond Fork Canyon in the vicinity of Three Forks.

Spanish Fork Canyon, located in southern Utah County east of the city of Spanish Fork, is characterized by steep mountains with abundant vegetation and wildlife on both the canyon floor and the surrounding mountains. The Spanish Fork River flows through the canyon year-round, providing unique visual features as well as plant and

wildlife habitat. Apart from the river, adjacent mountain peaks and smaller adjoining canyons add to the canyon's scenic value. A number of facilities have been constructed in Spanish Fork Canyon. These include Highway 6, two parallel railroad lines (the Denver and Rio Grande Western Railroad), the Strawberry Diversion Dam on the Spanish Fork River, various electrical transmission and distribution lines, a number of houses, and one- and two-lane bridges crossing the Spanish Fork River.

Southeastern Utah Valley, located in southern Utah County, has moderate levels of development for both agricultural production and residential housing. Located within this area are the cities of Springville, Mapleton, Spanish Fork, Salem, Payson, Santaquin, and Woodland Hills. In addition to the concentrated residential development within these cities, many rural residences are scattered throughout the valley floor, as well as on the western slopes of the Wasatch Mountains. Dispersed industrial facilities are located throughout the area, as are a number of linear infrastructure facilities, including roadways (most notably, Highway 6 and I-15) and electrical transmission and distribution lines. Numerous rivers and streams (including the Spanish Fork River, Hobble, Peteetneet, Summit, Spring, and Beer Creeks, and Benjamin Slough) and an extensive network of irrigation canals are also located within the southern valley. Most of the valley area not developed for residential and commercial use is used for agricultural production.

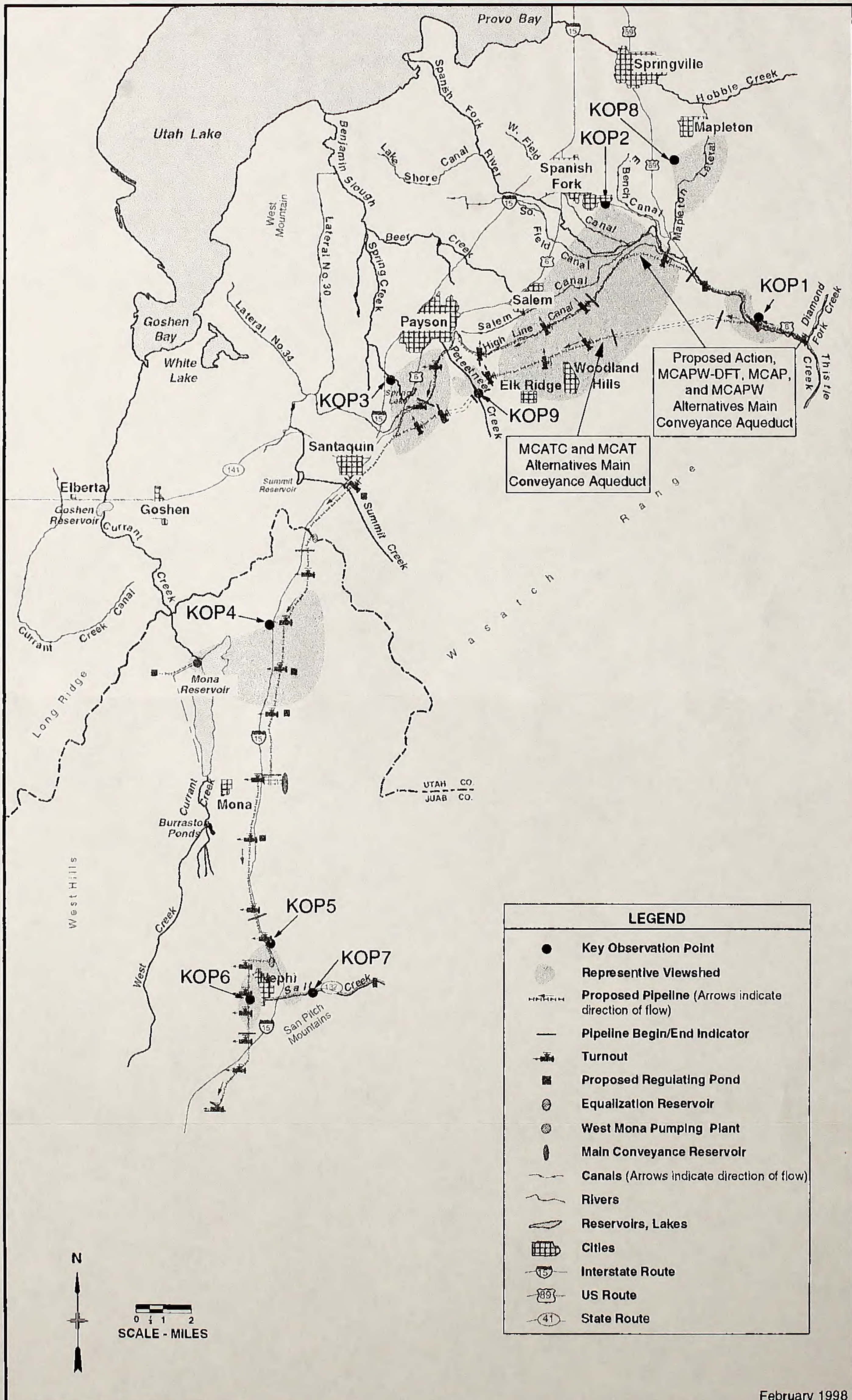
Many locations within southern Utah Valley offer unobstructed views of the Wasatch Mountains to the east and of the open expanses of the Utah Valley to the north and west. Nebo Loop Road, routed through Payson Canyon, is the only designated scenic highway from which SFN System construction or permanent facilities would be viewed.

In northern Juab Valley, the visual characteristics consist of wide open spaces on the valley floor and the abruptly rising Wasatch and San Pitch Mountains located to the east and south. Rural residential development exists in the valley but is limited, with most residential development concentrated within the towns of Mona and Nephi. Prominent water features within the area consist of Mona Reservoir, Burraston Ponds, Salt Creek, and Currant Creek. Much of northern Juab Valley is currently used for both irrigated and unirrigated agricultural production; large areas of unirrigated rangeland and undeveloped meadow land are also common in the area.

Many locations within the areas described above, while in the vicinity of the "Diamond Fork Tunnel Alternative" or the SFN System and related facilities, would not provide a clear or unobstructed view of these facilities. Further, many locations from which facilities could be observed are not often frequented by viewers. Therefore, the affected environment for visual resources is limited to areas from which facilities and/or construction activities would be seen by a number of viewers. To facilitate the evaluation of visual effects in Utah and Juab Valleys, Key Observation Points (KOPs) were designated from which the construction of the Main Conveyance Aqueduct and related actions could be seen by numerous persons. The visibility and visual impact of each alternative was evaluated for each KOP. The use of the KOPs provides a manageable way to define the visual impacts; the evaluations for some of the KOPs are also indicators of the visual effects expected in areas adjacent to the KOPs. The locations of these KOPs are shown on Map 3.14-1. No KOPs were designated in the Diamond Fork drainage to assist in the visual impact analysis for the "Diamond Fork Tunnel Alternative." Most of the public access in the Uinta National Forest upstream of the Monks Hollow-Three Forks area is along the narrow, curving creek bottoms, where trees would restrict the visibility of construction on the canyon sidehills.

3.14.5.1 Proposed Action

The existing viewsheds from KOPs 1 through 8 and the Uinta National Forest areas that would be affected by the Proposed Action are described below.



Map 3.14-1
KOPs and Representative Viewsheds
Within the Main Conveyance Aqueduct
Area of Influence

3.14.5.1.1 KOP 1. KOP 1 is located on Highway 6, north of the mouth of Pole Canyon, approximately midway between the mouth of Spanish Fork Canyon and the confluence of the Spanish Fork River and Diamond Fork Creek. From this KOP, the dominant features are Highway 6, the Spanish Fork River, and irrigated fields along the canyon floor. Looking toward Pole Canyon, the steep, vegetation-covered sides at the mouth of the canyon are visible, as well as a number of structures and a paved road leading toward the mouth of Pole Canyon. The Wasatch Mountains dominate the middleground and background views. The view from KOP 1 can be seen by both westbound and eastbound traffic on Highway 6.

3.14.5.1.2 KOP 2. KOP 2 is located on Highway 6, south of the town of Spanish Fork. The viewshed from KOP 2 that would contain SFN System facilities lies to the southeast, south, and southwest. Scattered residential development and agriculturally developed lands across the relatively level southeastern corner of Utah Valley can be seen in the foreground from KOP 2. The middleground consists of the bench area of the north-facing slopes of the Wasatch Range and contains scattered residential development (Woodland Hills and Elk Ridge) and agricultural lands throughout much of the landscape. The edge of the shelf created during construction of the Strawberry Power Canal and the High Line Canal can be seen where the canals run parallel to the upper portion of the bench. The background view from KOP 2 consists of the high peaks of the Wasatch Mountains. This view can be seen by both westbound and eastbound traffic on Highway 6 and by residents in the immediate area.

3.14.5.1.3 KOP 3. KOP 3 is located along I-15, approximately 2.5 miles southwest of the city of Payson. The viewshed from this KOP that would contain SFN System facilities lies to the northeast, east, and south. The foreground view is comprised of I-15 to the north and south, agricultural fields, and some scattered residential development to the northeast, east, and southeast. The middleground view from this point looking east contains the lower, western slopes of the Wasatch Mountains on which are located scattered residential development and agricultural lands. Portions of the side-cut of the High Line Canal can be seen running north to south along the west-facing slope. The background view consists of the high peaks of the Wasatch Mountains. The viewshed from KOP 3 is seen primarily by northbound and southbound traffic on I-15 as well as by residents in the area.

3.14.5.1.4 KOP 4. KOP 4 is located on I-15 west of the northern end of Mona Reservoir. The foreground and middleground views to the north, east, and south are comprised of I-15 and the sagebrush-covered, west-facing, lower slopes of the Wasatch Mountains. In the background to the east are the high peaks of the Wasatch Mountains. To the southwest and west are agricultural lands, Mona Reservoir, and the mountains of Long Ridge. This view is seen by both northbound and southbound traffic on I-15.

3.14.5.1.5 KOP 5. KOP 5 is located on I-15, 1 mile north of Nephi. The viewshed that would contain SFN System and related facilities lies to the northwest, southwest, and southeast. The view to the northwest consists of I-15 and agricultural lands in the foreground, middleground, and background. To the southeast is I-15, beyond which lies the Nephi golf course, with the nearby Wasatch Mountains dominating the middleground and background views. Beyond the town of Nephi lie open agricultural and undeveloped lands. This view is seen by both northbound and southbound traffic on I-15.

3.14.5.1.6 KOP 6. KOP 6 is located near the railroad in southwest Nephi, adjacent to Salt Creek. SFN System facilities would be located to the north, east, and south. The foreground view to the north and south contains numerous man-made structures. Salt Creek flows north and south from this point in an irrigation canal that is lined on the west side with riparian vegetation and by the railroad on the east. East of the railroad is a paved, low-traffic volume city street. To the west of the canal are a number of houses, some of which border on the canal. To the east of KOP 6 is a large abandoned ironworks building located on an otherwise barren lot. To the south of the lot, Salt Creek is diverted and its flows are directed to the north and south. Along this portion of the creek, there are scattered groves of trees, as well as other riparian vegetation. This view can be seen by traffic and pedestrians in the area. Through-traffic does not utilize the area.

3.14.5.1.7 KOP 7. KOP 7 is located on Highway 132, approximately 0.5 mile east of the mouth of Nephi Canyon. SFN System-related facilities would be located approximately 200 feet south of this point and to the west. This narrow canyon area is characterized by steep rock walls with vegetation occurring primarily along the base of the canyon near Salt Creek. Highway 132 crosses Salt Creek to the west and east of this point. A small powerhouse is located just north of the highway. This view can be seen by both eastbound and westbound traffic on Highway 132.

3.14.5.1.8 KOP 8. KOP 8 is located on Mapleton Road within the Mapleton city boundary. SFN System-related facilities would be located to the northeast, east, and southeast of this point. The foreground and middleground views from this KOP comprise scattered residential development, as well as agriculturally developed lands (orchards and irrigated farmlands). Additionally, the levees of the Mapleton Canal can be seen as an elevated ridge running south to north through irrigated agricultural lands. The background is the Wasatch Mountains. This view can be seen by traffic on Mapleton Road and from residences in the area.

3.14.5.1.9 Uinta National Forest. The "Diamond Fork Tunnel Alternative" would be constructed entirely on Uinta National Forest lands. The Main Conveyance Aqueduct would be located adjacent to Uinta National Forest at some areas within Spanish Fork Canyon and would cross approximately 2,300 feet of Uinta National Forest south of Santaquin.

3.14.5.1.9.1 Diamond Fork Drainage. The four areas affected by the construction of the "Diamond Fork Tunnel Alternative" are described here from upstream to downstream along its tunnels and pipelines. The first construction area would be required for the construction of the inlet to Tanner Ridge Tunnel, which would be adjacent to Sixth Water Creek near the outlet of the existing Sixth Water Aqueduct. This area is about 4.2 miles upstream of Three Forks. Sixth Water Creek occupies a narrow, V-shaped canyon bordered by steep slopes that are vegetated with shrubs and trees, interspersed with massive outcroppings of rock.

The second construction area would be located in upper Diamond Fork Canyon approximately 3 to 3.5 miles upstream of Three Forks. This area would contain the Tanner Ridge Tunnel outlet, the 1.4-mile-long Diamond Fork Siphon, and the Red Mountain Tunnel inlet. The creek bottom in this area is used by the public for sightseeing, picnicking, and fishing. It is accessible to the public by upper Diamond Fork Road, either from Spanish Fork Canyon or from Springville Crossing, which enters the canyon from above. The tree-lined creek bottom is somewhat wider than the creek bottom along the first 3 miles of upper Diamond Fork Creek. The sidehills, while extremely steep in places, are generally vegetated with brush and scrub oak without cliffs or massive rock outcrops. Man-made facilities are limited to the narrow (mostly one-lane) paved road along upper Diamond Fork Creek.

The third area is in Red Hollow, which branches off Diamond Fork Creek opposite Monks Hollow. Red Hollow would contain the outlet of Red Mountain Tunnel and over half the length of the Red Hollow Pipeline. Red Hollow is an extremely narrow V-shaped gorge for its first 0.75 mile, after which the bottom of the hollow widens gradually to form an open valley floor that once contained a ranch. Red Hollow is relatively isolated, with access provided by a narrow dirt road that is open for public access for approximately the first 0.75 mile, after which it is blocked by a locked gate to restrict public access.

The fourth area is a small area in Diamond Fork Canyon near Monks Hollow where the Red Hollow Pipeline would end along Diamond Fork Road. A pressure-reducing station, pipe connection to the end of the existing Diamond Fork Pipeline, and a turnout to Diamond Fork Creek would be constructed in this area. At Monks Hollow, Diamond Fork Canyon has a relatively wide bottom bordered by rock bluffs and steeply rising slopes with scattered shrubs and trees.

3.14.5.1.9.2 Spanish Fork Canyon. Approximately 1.5 miles of the Main Conveyance Aqueduct would be located 0.25 mile from Uinta National Forest boundary in Spanish Fork Canyon. The portions of the national

forest adjacent to the Main Conveyance Aqueduct have been designated as visual "Retention" areas. According to USFS guidelines, "Retention activities may *only* repeat form, line, color, and texture which are frequently found in the characteristic landscape. Changes in their quantities of size, amount, intensity, direction, pattern, etc., should not be evident" (USDA 1975).

3.14.5.1.9.3 Southern Utah County. The Main Conveyance Aqueduct would be located on Uinta National Forest lands at two places in Utah County south of the Spanish Fork area. The first location would be east of Spring Lake, where the Payson Pipeline would be sited on national forest lands for about 1,300 feet on the alignment currently occupied by the High Line Canal. The second is east of Santaquin, where the Santaquin Pipeline would be sited on national forest lands for a distance of approximately 1,000 feet on sloping foothill terrain with scattered scrub oak vegetation. At the second location, the pipeline would be parallel to and about 1,500 feet east of I-15, adjacent to a rural residential area interspersed with pastures. USFS lands that would be crossed are designated as visual "Partial Retention" areas. According to USFS guidelines, activities within Partial Retention areas "May repeat form, line, color, or texture common to the characteristic of the landscape but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape" (USDA 1975).

3.14.5.2 MCAPW-DFT Alternative

The MCAPW-DFT Alternative is similar to the Proposed Action in layout and affected environment, except that 1) a turnout would be constructed at the end of the Diamond Fork Pipeline and 2) the Salem Bench and Payson Pipelines of the Main Conveyance Aqueduct would be constructed parallel to the High Line Canal instead of replacing it. The visual impacts resulting from the construction and operation of the MCAPW-DFT Alternative would not be significantly different from those described for the Proposed Action.

Construction of the Main Conveyance Aqueduct parallel to the High Line Canal would produce a wider, more visible construction scar during construction. However, because the new aqueduct alignment would be located primarily on agricultural land and grassland, construction would not produce a permanent scar.

3.14.5.2.1 Uinta National Forest. The "Diamond Fork Tunnel Alternative" would result in the same visual impacts as described for the Proposed Action. The Main Conveyance Aqueduct in the MCAPW-DFT Alternative would be located on Uinta National Forest lands south of Spanish Fork at the same two locations as described for the Proposed Action, but one would have a different length. The first location and length, east of Spring Lake, are identical to the Proposed Action, consisting of about 1,300 feet on the alignment currently occupied by the High Line Canal. The second location, east of Santaquin, would consist of about 1,900 feet on the east side of the High Line Canal. These locations are categorized as visual "Partial Retention" areas, as described in Section 3.14.5.1.9.3.

3.14.5.3 MCAP Alternative

The visual character of the Main Conveyance Aqueduct would be the same as that described for the Proposed Action. The MCAP Alternative would not contain the "Diamond Fork Tunnel Alternative." Instead, Monks Hollow Dam and Reservoir would be constructed.

3.14.5.3.1 Uinta National Forest. The MCAP Alternative would be accompanied by the construction of Monks Hollow Dam and Reservoir in the Diamond Fork drainage. The dam and reservoir, described with the MCAP Alternative in Section 1.6.4, would inundate the creek bottom for approximately 2.5 miles upstream, including Three Forks. Monks Hollow Dam would greatly alter the visual nature of Diamond Fork Canyon at Monks Hollow. Moreover, Monks Hollow Dam and Reservoir would block vehicular traffic along Diamond Fork Canyon at Monks Hollow and thus require motorists to reach upper Diamond Fork Canyon for sightseeing or other purposes from Springville (along Hobble Creek) or from Rays Valley Road. A trail would be provided from

below Monks Hollow Dam to the Three Forks area for non-motorized access to Sixth Water Creek and upper Diamond Fork Creek.

The construction of Monks Hollow Dam and Reservoir would require a 2.3-mile-long access road around the dam site. The access road would begin at the existing Diamond Fork Road about 1.1 miles downstream of the Monks Hollow Dam site and traverse the bench land on the north side of the creek to the existing Red Hollow Road, which would provide access into the reservoir area. Ultimately, this road would become a permanent road providing access to a recreation area along the shore of the reservoir.

The impacts of the MCAP Alternative on Uinta National Forest lands in Spanish Fork Canyon and in Utah Valley near Santaquin would be the same as those described for the Proposed Action.

3.14.5.4 MCAPW Alternative

The Main Conveyance Aqueduct in the MCAPW Alternative would be the same as in the MCAPW-DFT Alternative, as would the turnout at the end of the Diamond Fork Pipeline. The MCAPW Alternative would not contain the "Diamond Fork Tunnel Alternative." Instead, the Diamond Fork System would be completed with the construction of Monks Hollow Dam and Reservoir as in the MCAP Alternative.

In the MCAPW Alternative, the visual impacts of the Main Conveyance Aqueduct, its related actions, and the turnout at the end of the Diamond Fork Pipeline would be identical to those of the MCAPW-DFT Alternative. The visual impacts of Monks Hollow Dam and Reservoir would be the same as in the MCAP Alternative.

3.14.5.4.1 Uinta National Forest. Under the MCAPW Alternative, Monks Hollow Dam and Reservoir would be constructed and would cause the same visual impacts to Diamond Fork Canyon as identified in the MCAP Alternative. In Spanish Fork Canyon, the relationship of the Main Conveyance Aqueduct alignment to Uinta National Forest lands would be the same as that described in the Proposed Action. The Main Conveyance Aqueduct in the MCAPW Alternative would be located on Uinta National Forest lands east of Spring Lake and east of Santaquin as described for the MCAPW-DFT Alternative.

3.14.5.5 MCATC Alternative

The impact area of influence for the MCATC Alternative would be similar to that of the MCAP Alternative. KOPs 1 through 8, as described in Section 3.14.5.1, are applicable to the MCATC Alternative. One additional KOP has been established to represent the affected environment for this alternative, and some variation exists on USFS lands. These differences are described below.

3.14.5.5.1 KOP 9. KOP 9 is located on the Nebo Loop Road in Payson Canyon, approximately 1.5 miles southeast of the mouth of the canyon. Nebo Loop Road is a designated Scenic Highway that winds through the base of Payson Canyon paralleling Peteetneet Creek. Steep, densely vegetated canyon walls ascend from the creek on the east and from the highway on the west. Located at KOP 9 is a small, cement-lined irrigation water storage reservoir. This view can be seen by both northbound and southbound traffic on the Nebo Loop Road.

3.14.5.5.2 Uinta National Forest. As a result of the MCATC Alternative, the Main Conveyance Aqueduct would also be located adjacent to the Uinta National Forest at some areas within Spanish Fork Canyon and would cross approximately 2,000 feet of the Uinta National Forest south of Santaquin. Some segments of the Tithing and Dry Mountain Tunnel alignments would be located beneath USFS lands but would not affect the visual characteristics of the land above them.

3.14.5.5.2.1 Spanish Fork Canyon. In Spanish Fork Canyon, approximately 0.5 mile of the Main Conveyance Aqueduct and 1 mile of the Mapleton distribution pipeline would be located approximately 0.25 mile from the

Uinta National Forest boundary. Similar to the Proposed Action, these portions of the Main Conveyance Aqueduct are located adjacent to USFS lands designated as visual "Retention" areas.

3.14.5.6 MCAT Alternative

The affected environment for the MCAT Alternative would be the same as that described for the MCATC Alternative except that KOP 8 would not apply because no improvements to the Mapleton distribution pipeline would be planned under this alternative. There would be no impacts to USFS lands adjacent to KOP 8.

3.14.5.7 No Action Alternative

The No Action Alternative would consist of completing the Diamond Fork System with the construction of Three Forks Dam and Reservoir. Three Forks is the area at which Sixth Water and Cottonwood Creeks join upper Diamond Fork Creek to form lower Diamond Fork Creek. At Three Forks, Diamond Fork Canyon has a distinct transition in bottom width. The gradually narrowing lower canyon with its gravel-bottomed, meandering stream terminates into a widened area containing the confluence of the three creeks. Upstream of Three Forks, upper Diamond Fork Creek, Sixth Water Creek, and Cottonwood Creek flow through narrow, V-shaped canyons. The creek bottoms are typically bordered by steep slopes vegetated with shrubs and trees, interspersed with massive outcroppings of rock. These narrow canyons are visually appealing to motorists along upper Diamond Fork Creek and hikers and mountain bikers along the trails along Sixth Water and Cottonwood Creeks.

3.14.6 Impact Analysis

3.14.6.1 Significance Criteria

Visual impacts were assessed using the following two duration-related criteria and USFS visual guidelines:

Short-Term: Short-term impacts are those that would occur for less than 3 years. Short-term impacts are considered significant if they meet one of the following criteria:

- The total disturbed area visible to a viewer is more than 5 acres or the visual experience would continue for several miles of travel, such as along a rural highway or within a national forest.
- The affected area possesses unique characteristics within the larger geographic area, such as visual proximity to historical or cultural resources, major trails, recreation areas, park lands, scenic corridors, major roads, designated wild and scenic rivers, or communities.

Long-Term: Long-term visual impacts are those that would occur for more than 3 years following the completion of construction activities. Long-term impacts are considered significant if they meet one of the following criteria:

- The area has high sensitivity because of its proximity to historical or cultural resources, major trails, recreation areas, park lands, scenic corridors, major roads, rivers, or communities.
- The project would dominate the attention of the viewer.

Violation of USFS Visual Quality Objectives (VQOs): Any violation of VQOs for Preservation, Retention, Partial Retention, or Modification of USFS lands is considered significant. Violation of these VQOs would include the following:

- Permanent changes to the visual environment other than ecological changes
- Direct, permanent changes to the existing character of the landscape
- Changes to a visual resource that would require more than 3 years to restore to its original character
- Permanent changes to visual contrast as related to spatial characteristics, visual scale, texture, line, and color

3.14.6.2 Potential Impacts Eliminated from Further Analysis

Anticipated improvements to on-farm irrigation systems and construction of new city M&I water wells, identified in Section 1.9, Related Actions (Local Development), would not result in a measurable visual quality impact as irrigation facilities or scattered well sites do not dominate the landscape.

3.14.6.3 Proposed Action

The following sections describe the potential impacts to visual resources resulting from the construction and operation of the Proposed Action. Visual impacts of the Main Conveyance Aqueduct are described primarily in terms of visibility at eight KOPs in southern Utah Valley. The visual impacts of the "Diamond Fork Tunnel Alternative," which would be observable from isolated places, are described under the subheading "Uinta National Forest." Impacts are summarized in Section 3.14.6.10.

3.14.6.3.1 KOP 1. Visual impacts at KOP 1 would occur to both westbound and eastbound travelers on Highway 6. The duration of this view would most commonly be less than 1 minute.

3.14.6.3.1.1 Short-Term Impacts. Construction activities would be readily apparent. Earth-moving activities along the Main Conveyance Aqueduct right-of-way would result in visible trenches and cleared areas as well as a concentration of construction vehicles, equipment, and personnel. Construction activities would be relatively short in duration (see Section 1.6.2.10) and would not result in extended periods of construction activity or construction equipment storage within any one viewshed. Construction activities would not result in a significant visual impact. Visual impacts resulting from construction activities would be similar for all representative viewsheds unless otherwise noted. Following completion of construction activities, disturbed areas would be recontoured and revegetated. It is likely that successful revegetation could take up to 3 years. Until successful revegetation occurs, noticeable disturbance would likely be visible where construction activities had taken place. This disturbance would not dominate the landscape; however, it would be visible from Highway 6 for approximately 3 miles in Spanish Fork Canyon. Until successful revegetation has occurred, this noticeable disturbance would be a significant short-term visual impact.

3.14.6.3.1.2 Long-Term Impacts. No long-term visual impacts would be expected to occur within the KOP 1 viewshed. Following restoration of the right-of-way, the pipeline alignment would not be noticeable to the average viewer. Marker posts would be placed along the centerline of the alignment (see Section 1.6.2.10.4). Marker posts would not be readily apparent to the casual observer and would be placed at intervals of up to 0.5 mile between posts. Their presence would not dominate the attention of the viewer and would not result in a significant visual impact.

3.14.6.3.2 KOP 2. SFN System facilities that would be visible from KOP 2 include the Main Conveyance Aqueduct right-of-way along the existing High Line Canal alignment, the South Field distribution pipeline right-of-way, and the Salem distribution pipeline right-of-way. Each of these facilities would be in the middleground view from KOP 2 and would not dominate the view.

3.14.6.3.2.1 Short-Term Impacts. The Main Conveyance Aqueduct and the distribution pipelines would be at elevations higher than this KOP. Looking upslope toward the locations of the new pipelines, very few features

of the SFN System would be seen from KOP 2 and the surrounding area. No significant short-term impacts to the visual quality of the area would be expected.

3.14.6.3.2.2 Long-Term Impacts. No long-term visual impacts resulting from the Proposed Action would be expected within the KOP 2 viewshed. Following revegetation, the right-of-way would blend with the natural characteristics of the landscape and would not be noticeable. Segments of the recreation trail would likely be visible from KOP 2. The visual impacts resulting from the presence of a recreation trail are highly subjective; the trail would not dominate the view. Therefore, no significant visual impacts would be expected at this KOP.

3.14.6.3.3 KOP 3. Visual quality impacts associated with KOP 3 would include construction activities associated with the Main Conveyance Aqueduct, as well as the placement of the recreation trail following construction. The duration of the view would be short (less than 2 minutes) for interstate travelers through this area.

3.14.6.3.3.1 Short-Term Impacts. The Main Conveyance Aqueduct would be at an elevation higher than this KOP. Looking upslope toward the Main Conveyance Aqueduct, very few project features would be seen from KOP 3 and the surrounding area; however, some ground disturbance would likely be visible. Visible disturbance would not be greater than 5 acres and would not dominate the landscape or have significant visual impacts.

3.14.6.3.3.2 Long-Term Impacts. As a result of the Proposed Action, the recreation trail would be a permanent visible structure. Some portions of the recreation trail would likely be visible from KOP 3. However, visual impacts occurring from the presence of a recreation trail are highly subjective and not necessarily adverse. The recreation trail would not dominate the landscape, nor would it be expected to significantly detract from the visual quality of the area.

3.14.6.3.4 KOP 4. SFN System and related facilities within view of KOP 4 would include the West Mona Pumping Plant to the west, the Main Conveyance Reservoir east of Mona, the EJ3 regulating pond and distribution pipeline, and the Main Conveyance Aqueduct right-of-way. These features could generally be seen by both northbound and southbound traffic on I-15. From the general location of KOP 4, these features could be seen for up to 3 minutes as interstate users pass through the area.

3.14.6.3.4.1 Short-Term Impacts. During construction, vehicles used for excavating the Main Conveyance Aqueduct and distribution pipelines, regulating ponds, and water storage reservoirs would be readily visible to interstate users. However, construction of these features would occur in a relatively limited space and would not dominate a significant portion of the view. Construction of the West Mona Pumping Plant would likely be visible, but would be more than 3 miles from I-15 and not noticed by the average viewer. This action would not result in a significant visual impact. Following the completion of construction, there would be noticeable soil disturbance along the Main Conveyance Aqueduct right-of-way. As viewed perpendicular to the interstate, the disturbance would not dominate the view. However, when viewed lengthwise parallel to I-15, the disturbed area would be noticeable for several miles along I-15. This disturbance would result in a significant short-term visual impact until successful revegetation would occur.

3.14.6.3.4.2 Long-Term Impacts. Long-term impacts within the KOP 4 viewshed would result from the following permanent, aboveground SFN System facilities: the West Mona Pumping Plant, EJ3 regulating pond, and Main Conveyance Reservoir. The West Mona Pumping Plant, as viewed from KOP 4, would not be noticeable to the average viewer and, combined with the short duration of the view, would result in the pumping plant having little or no impact on the view of Mona Reservoir and the surrounding area. Once constructed, the EJ3 regulating pond and the Main Conveyance Reservoir would be visible from I-15. Even though both would be located on land that is elevated above I-15, the average viewer would see the north, west, and south compacted earthen sides and chain-link fencing surrounding the pond and reservoir (Figures 1-6 and 1-8 in Chapter 1 show a typical regulating pond and the Main Conveyance Reservoir, respectively). These structures would add contour and diversity to the middleground view as seen from the interstate. As man-made structures, these facilities would detract somewhat

from the natural visual quality of the landscape, but would not dominate the view. No long-term visual impacts would be expected to occur at this KOP.

3.14.6.3.5 KOP 5. SFN System features within view of KOP 5 would include the Main Conveyance Aqueduct right-of-way, an equalization reservoir, and the Salt Creek Pipeline right-of-way. Operations during the construction of these features could generally be seen by both northbound and southbound traffic on I-15. From the general location of KOP 5, these features would be visible for less than 2 minutes as interstate users pass through the area.

3.14.6.3.5.1 Short-Term Impacts. During construction, vehicles used for excavating the Main Conveyance Aqueduct, Salt Creek Pipeline, and equalization reservoirs would be readily visible to interstate users. However, construction of these features would occur in a relatively limited space and would not dominate a significant portion of the view. Impacts would be temporary and not significant. Following the completion of construction, there would be noticeable scars resulting from soil disturbance along the Main Conveyance Aqueduct and Salt Creek Pipeline right-of-way and at the buried equalization reservoir. As viewed perpendicular to I-15, the disturbance would not dominate the view. However, when viewed lengthwise parallel to I-15, the disturbed area would be noticeable and would likely dominate the middleground view. The duration of this impact would occur until successful revegetation of the right-of-way blended the disturbed soils with the surrounding area. Revegetation in accordance with the *Erosion Control, Revegetation, and Maintenance Plan* (see Appendix A) would not result in a significant impact.

3.14.6.3.5.2 Long-Term Impacts. No long-term or permanent visual impacts would occur within the viewshed of KOP 5 as a result of the SFN System or local development activities. Following revegetation, the pipeline right-of-way and the surface of the equalization reservoir would blend with the characteristics of the landscape and would not be noticeable to the average viewer.

3.14.6.3.6 KOP 6. SFN System and local development facilities within the viewshed of KOP 6 would include the Main Conveyance Aqueduct right-of-way and the Nephi Pumping Plant. The area around KOP 6 does not experience high volumes of vehicular or pedestrian traffic. Viewers of construction activities and resulting SFN System and local development facilities would consist primarily of local residents and irrigators who access their fields via this area. Construction of the Main Conveyance Aqueduct and the Nephi Pumping Plant would alter the existing visual environment within the KOP 6 viewshed.

3.14.6.3.6.1 Short-Term Impacts. Following the completion of construction, disturbed areas along the Main Conveyance Aqueduct right-of-way would be visible. This disturbance would be located along the railroad, a dominant linear feature, and would not dominate the view.

3.14.6.3.6.2 Long-Term Impacts. The channelized portion of Salt Creek paralleling the railroad would be dewatered, excavated, and replaced with the Main Conveyance Aqueduct. Much of the existing vegetation along this portion of Salt Creek would also be removed. Permanent loss of the aesthetic value of the channelized portion of Salt Creek would occur. Because of the location of this visual feature in relation to residences, its permanent loss would be considered significant. The Nephi Pumping Plant would be visible to the east of KOP 6, and the ironworks shop would be removed, altering the visual character of the area. The pumping plant is not expected to detract from the existing visual quality of the area because it would replace an existing structure that is currently in ill repair and would not result in a significant impact. However, it would likely dominate the view from KOP 6 and, therefore, would be a significant visual impact.

3.14.6.3.7 KOP 7. Local development facilities within the viewshed of KOP 7 would be the Salt Creek Diversion Dam and Salt Creek Pipeline right-of-way. These features would be within view of the moderate traffic volumes on Highway 132. During construction, the viewing period could be up to 15 minutes as traffic controls would

be necessary during construction of the Salt Creek Pipeline as it crosses the highway. Following the completion of construction, the viewing period through this area would be less than 1 minute for most motorists.

3.14.6.3.7.1 Short-Term Impacts. The Salt Creek Pipeline would be buried; ground disturbed during construction would be noticeable only until successful revegetation occurred. Revegetation in accordance with the *Erosion Control, Revegetation, and Maintenance Plan* (see Appendix A) and restoration of golf course landscape, where necessary, would not result in a significant impact.

3.14.6.3.7.2 Long-Term Impacts. The Salt Creek Diversion Dam would be a new, permanent feature on Salt Creek. The concrete diversion dam would be located within the creek channel; therefore, it would be relatively unintrusive on the surrounding landscape, would not dominate the view, and would not be a significant impact. No long-term impacts would be associated with the Salt Creek Pipeline. Following revegetation, the right-of-way would blend with the natural characteristics of the landscape and would not be noticeable to the average viewer.

3.14.6.3.8 KOP 8. Local development facilities within the viewshed of KOP 8 would be the Mapleton distribution pipeline right-of-way. The Mapleton distribution pipeline would be a buried pipeline that would replace the existing Mapleton Canal. Viewers of the KOP 8 viewshed would consist primarily of eastbound, local commuting traffic on Mapleton Road. The view of the Mapleton distribution pipeline from this area would typically be less than 2 minutes in duration.

3.14.6.3.8.1 Short-Term Impacts. During the construction of the Mapleton distribution pipeline, equipment used for excavating the existing canal would be visible in the middleground view of eastbound Mapleton Road motorists. However, construction of this feature would occur in a relatively limited space and would not dominate a significant portion of the view. Therefore, impacts would be temporary and not significant. Following completion of construction, disturbed areas would be recontoured and returned to production with the possible exception of an access road remaining along the right-of-way. The Mapleton distribution pipeline would be at an elevation higher than the KOP. The disturbed areas would not be predominant in the viewshed when looking upslope toward the pipeline and would not result in a significant impact.

3.14.6.3.8.2 Long-Term Impacts. The existing Mapleton Canal would be dewatered and removed from service during construction of the distribution pipeline; however, because water flowing to the canal cannot presently be seen from KOP 8, eliminating this aspect would not be a visual impact from this viewpoint. Following the return of the pipeline right-of-way to agricultural production, the pipeline right-of-way would not be visible and would have no impact on the visual quality of the area.

3.14.6.3.9 Uinta National Forest

3.14.6.3.9.1 Diamond Fork Drainage. The rugged natural terrain of the creek bottoms and canyons in the upper Diamond Fork drainage make these popular scenic attractions to the motoring and hiking public. Although the creek bottoms upstream of Monks Hollow are narrow and views are short because of their irregular alignments, the scenery is popular with the public. The Uinta National Forest corridor along Diamond Fork Creek has been designated as a visual "Retention" area, as defined in Section 3.14.5.1.9.1. The Uinta National Forest corridor along Sixth Water Creek has been designated as a visual "Partial Retention" area, as defined in Section 3.14.5.1.9.2. The four construction areas for the "Diamond Fork Tunnel Alternative" vary in their accessibility and visibility to the public. The following discussion of construction impacts covers the four areas in sequence from upstream to downstream.

The first construction area would be for the inlet to Tanner Ridge Tunnel next to Sixth Water Creek. This area is accessible to the public only by a pack trail 4.2 miles upstream on Sixth Water Creek or by non-motorized travel along the operation and maintenance access road from Rays Valley. Consequently, construction activity and the remaining structural evidence of the tunnel would be visible to a very limited number of persons.

The second construction area in upper Diamond Fork Canyon, from approximately 3 to 3.5 miles upstream of Three Forks, is used by the public for sightseeing, picnicking, and fishing. It is accessible to the public by upper Diamond Fork Road, either from Spanish Fork Canyon or from Springville Crossing, which enters the canyon from above. The outlet of Tanner Ridge Tunnel, from which the tunnel would be constructed, would be located high on the south side of the canyon. The 1.4-mile Diamond Fork Siphon would begin there, descend the irregular south side of the canyon, run downstream for a distance along the upper Diamond Fork Creek bottom, where it would also cross the creek and then ascend the irregular north side of the canyon to the Red Mountain Tunnel inlet. The Red Mountain Tunnel inlet would be located at a higher elevation on the north side of the canyon. In the area of the Diamond Fork Siphon, the tree-lined creek bottom is somewhat wider, and the sidehills are predominantly vegetated with brush and scrub oak. From the paved road along the creek, new access roads would be constructed along both sides of the canyon to the two tunnels. The access roads would become permanent operation and maintenance roads. The alignments of these access roads would be selected to minimize scarring of the hillsides, through consultation with the USFS.

Public access to upper Diamond Fork Canyon between Three Forks and approximately 4 miles upstream of Three Forks would be limited to a few hours a day during the construction of the Diamond Fork Siphon and the tunnels because space in the canyon bottom is severely limited. Moreover, the views from the bottom of upper Diamond Fork Canyon are short because of its curves and trees. Thus, the disturbance to Diamond Fork Canyon would not be visible to the public during construction.

For several years following the completion of construction, disturbance in the form of bare earth and newly placed rock would be obvious. In the long-term future, after the creek restoration and adjacent revegetation measures blend with the surrounding vegetation, the creek bottom would regain its visual attractiveness. The sections of the permanent access roads cut into steep rocky hillsides would not be revegetated but would remain as exposed excavated surfaces. However, the trees lining the canyon bottom would limit the visibility of these excavated surfaces to scattered places along the creek bottom, and they would not have a dramatic effect on the scenic character of the canyon.

The third area, Red Hollow, would be affected by the construction of Red Mountain Tunnel and Red Hollow Pipeline. Red Hollow is accessible only by means of a dirt road. Construction of new access roads would be required to the outlet of Red Mountain Tunnel (from which the tunnel would be constructed) and along the alignment of the Red Hollow Pipeline. The access road to Red Mountain Tunnel outlet would become a permanent access road for required operation and maintenance. These access roads were described in Section 1.6.2.11. Currently, only the first 0.75 mile of the dirt road into Red Hollow is open to the public; the rest is restricted by the USFS for wildlife management reasons. During construction, the public would be excluded from all of Red Hollow. The construction disturbance would be short-term, continuing until the pipe trench of the Red Hollow Pipeline has been revegetated. However, the exclusion of the public from Red Hollow during construction and for an indefinite number of years following would preclude public exposure to the construction disturbance. If the USFS permits public access to Red Hollow in the future, visitors would encounter a barely detectable, but not visually degraded construction zone.

The fourth area is Diamond Fork Canyon near Monks Hollow, where the Red Hollow Pipeline would end with a pressure-reducing station, a connection to the end of the existing Diamond Fork Pipeline, and a turnout to Diamond Fork Creek. At Monks Hollow and for about 1 mile upstream, Diamond Fork Canyon has a relatively wide bottom bordered by steeply rising slopes with a light cover of grasses, shrubs, and trees. This site lies along Diamond Fork Road near Monks Hollow.

Construction in the areas described above would be accompanied by contractor staging areas and waste material disposal sites, as described in Section 1.6.2.12.

3.14.6.3.9.2 Spanish Fork Canyon. While the Main Conveyance Aqueduct would be located close to the Uinta National Forest along portions of the alignment through Spanish Fork Canyon, it would not actually enter the national forest, nor would it have a significant visual impact on either the view into or from the national forest at these locations.

3.14.6.3.9.3 South of Santaquin. The Main Conveyance Aqueduct crosses approximately 2,300 feet of the Uinta National Forest south of the town of Santaquin. This area of the national forest is designated as Partial Retention by the USFS. The construction of a buried pipeline in this area of the national forest would be consistent with USFS policies as long as the pipeline right-of-way was revegetated to blend with the naturally existing landscape (Christiansen 1995).

3.14.6.3.10 Mitigation. The construction scars caused by the pipeline trench excavation and backfill, access road construction, and disposal of earth and rock waste from tunnel excavation and access road excavation in upper Diamond Fork Canyon would be restored to as near natural state as possible after construction. Restoration would consist of grading exposed soil to achieve natural-appearing contours and avoid erosion as well as reseeding slopes with native grasses under a plan to be developed with the USFS. The fish and wildlife habitat along Diamond Fork and Sixth Water Creeks and the creek in Red Hollow would be restored, which would also restore their visual qualities (see Appendix A, *Erosion Control, Revegetation, and Maintenance Plan*). To mitigate for the removal of trees along the irrigation canal in west Nephi, saplings would be provided at no cost to affected residences, with the stipulation that these trees could not be planted in the pipeline right-of-way.

3.14.6.3.11 Unavoidable Adverse Impacts

3.14.6.3.11.1 Unavoidable Adverse Short-Term Impacts. Construction activities in the Diamond Fork drainage would require the closure of upper Diamond Fork Canyon to the public for approximately 3 years. Construction disturbance visible to the public elsewhere in the Diamond Fork drainage would not be mitigated. Visible temporary land disturbance along the Main Conveyance Aqueduct near Highway 6 and I-15 would not be mitigated and would result in an unavoidable adverse impact until successful revegetation occurs.

3.14.6.3.11.2 Unavoidable Adverse Long-Term Impacts. Even with restoration as described above, the permanent access roads in upper Diamond Fork Canyon would remain as visible scars, particularly where the roads are "benched" into rocky terrain. This would be incompatible with the current visual "Retention" categorization of the creek corridor by the USFS and would change the categorization to "Partial Retention" in the affected length of the narrow canyon. However, as discussed above, the trees lining the canyon are would greatly reduce the visibility of these disturbed areas to motorists or recreationists using the canyon area. The tunnel portals in upper Diamond Fork Canyon would not be visible from the creek area. The permanent loss of part of the channelized portion of Salt Creek along the railroad would be a significant unavoidable visual impact. Additionally, trees given to residents to mitigate for the loss of vegetation along this portion of the creek would require as long as 10 to 15 years to mature to the point at which they would actually mitigate visual impacts. In the meantime, the absence of the existing vegetation would be a significant unavoidable impact. The presence of the Nephi Pumping Plant would also be a significant unavoidable impact.

3.14.6.4 MCAPW-DFT Alternative

The visual impacts of the MCAPW-DFT Alternative would be the same as those described for the Proposed Action, except for the following items.

The turnout at the end of the Diamond Fork Pipeline and its discharge pipe would be noticeable primarily to motorists turning onto Diamond Fork Canyon Road from Highway 6 and only during construction. The turnout would be partially masked by existing farmstead buildings and vegetation. This section of canyon has wet soil, which would facilitate natural revegetation within 3 years.

At KOP 3, the Main Conveyance Aqueduct would be constructed parallel to the High Line Canal, which would produce a wider, more visible construction scar. However, because the new aqueduct alignment is primarily on agricultural land and grassland, the scar would not be permanent. The short-term impacts would be essentially the same as for the Proposed Action. Following revegetation, the right-of-way would blend with the natural characteristics of the landscape and would not be noticeable to the average viewer. The recreation trail would not be constructed under the MCAPW-DFT Alternative.

3.14.6.4.1 Uinta National Forest. The impact of the Main Conveyance Aqueduct and its related facilities and related actions (local development) on Uinta National Forest lands would be the same as that described for the Proposed Action.

3.14.6.4.2 Mitigation. Mitigation for visual impacts under the MCAPW-DFT Alternative would be the same as that described for the Proposed Action.

3.14.6.4.3 Unavoidable Adverse Impacts. Long-term unavoidable adverse impacts resulting from the MCAPW-DFT Alternative would be the same as those described for the Proposed Action.

3.14.6.5 MCAP Alternative

Visual impacts resulting from the construction and operation of the MCAP Alternative would consist of 1) those presented under the Proposed Action for the Main Conveyance Aqueduct, its associated facilities, and related actions (local development), and 2) those resulting from the construction of Monks Hollow Dam and Reservoir.

3.14.6.5.1 Uinta National Forest. The impact of the MCAP Alternative on Uinta National Forest land in the Diamond Fork drainage would be related to the construction of Monks Hollow Dam and Reservoir, which would alter the visual character of Diamond Fork Canyon in the vicinity of the dam and reservoir. The progression of valley and canyon vistas seen by visitors as they drive along Diamond Fork Road would end abruptly at the dam where the existing Diamond Fork Road would be terminated. Upper Diamond Fork Canyon would be accessible only from Rays Valley or Hobble Creek.

The 2.3-mile access road around the north end of Monks Hollow Dam would be visible only from Diamond Fork Road where it branches from that road. The impact of the MCAP Alternative on Uinta National Forest lands in Spanish Fork Canyon and near Santaquin would be the same as that described for the Proposed Action.

3.14.6.5.2 Mitigation. The same mitigation would be provided for Main Conveyance Aqueduct construction as under the Proposed Action.

3.14.6.5.3 Unavoidable Adverse Impacts. Completion of the Diamond Fork System with Monks Hollow Dam would terminate the scenic drive along Diamond Fork Road at Monks Hollow and thus prevent motorized access to upper Diamond Fork Canyon from Spanish Fork Canyon.

3.14.6.6 MCAPW Alternative

The visual impacts of the MCAPW Alternative Main Conveyance Aqueduct and related actions (local development) would consist of the same impacts as the MCAPW-DFT Alternative. The MCAPW Alternative would also include the impacts of the turnout at the end of the Diamond Fork Pipeline, described under the MCAPW-DFT Alternative, and the impacts of constructing Monks Hollow Dam and Reservoir, described under the MCAP Alternative. The recreation trail would not be constructed under the MCAPW Alternative.

3.14.6.6.1 Uinta National Forest. The impact of the MCAPW Alternative on Uinta National Forest land in Spanish Fork Canyon and near Santaquin would be the same as that described for the Proposed Action. The

impact of the MCAPW Alternative on Uinta National Forest lands in Diamond Fork Canyon related to Monks Hollow Dam and Reservoir would be the same as that described for the MCAP Alternative.

3.14.6.6.2 Mitigation. The same mitigation would be provided for Main Conveyance Aqueduct construction as described under the Proposed Action.

3.14.6.6.3 Unavoidable Adverse Impacts. Completion of the Diamond Fork System with Monks Hollow Dam would terminate the scenic drive along Diamond Fork Road at Monks Hollow and thus prevent motorized access to upper Diamond Fork Canyon from Spanish Fork Canyon.

3.14.6.7 MCATC Alternative

The visual impacts resulting from the construction and operation of the MCATC Alternative that be the same as those of the Proposed Action except as discussed below. These impacts are summarized in Section 3.14.6.10. Unless otherwise noted, all short-term impacts of the Proposed Action also apply to the MCATC Alternative.

3.14.6.7.1 KOP 2. SFN System facilities that would be visible from KOP 2 include the Main Conveyance Aqueduct right-of-way along the bench above the existing High Line Canal alignment; the MCATC Alternative SU2 through SU4 distribution pipeline rights-of-way aligned south to north from the Main Conveyance Aqueduct to the existing High Line Canal alignment; the South Field distribution pipeline right-of-way; and the Salem distribution pipeline right-of-way. These facilities are in the middleground view from KOP 2 and do not dominate the view.

3.14.6.7.2 KOP 3. The only SFN System-related feature resulting from the MCATC Alternative visible from KOP 3 would be the Main Conveyance Aqueduct right-of-way. The recreation trail would not be constructed as a result of the MCATC Alternative.

3.14.6.7.2.1 Long-Term Impacts. No long-term visual impacts would occur within this viewshed as a result of the MCATC Alternative. Following revegetation, the right-of-way would blend with the natural characteristics of the landscape and would not be noticeable to the average viewer.

3.14.6.7.3 KOP 9. The viewshed from KOP 9 contains right-of-way that would be used by the MCATC Alternative Main Conveyance Aqueduct. Visual impacts would occur to both northbound and southbound travelers on the Nebo Loop Road for a period of less than 1 minute.

3.14.6.7.3.1 Short-Term Impacts. Following completion of construction, disturbed areas would be recontoured and revegetated. It is likely that successful revegetation could take up to 3 years. Until successful revegetation occurs, disturbance would likely be visible where construction activities had taken place. This disturbance, however, would not dominate the landscape because of existing disturbance and developed facilities in the immediate area. There would be minimal impacts to the visual quality of the area.

3.14.6.7.3.2 Long-Term Impacts. No long-term visual impacts are expected to occur within the KOP 9 viewshed as a result of the MCATC Alternative. Following revegetation, the right-of-way would blend with the natural characteristics of the landscape and would not be noticeable to the average viewer.

3.14.6.7.4 Mitigation. Mitigation for the Main Conveyance Aqueduct under the MCATC Alternative would be the same as that described for the Proposed Action.

3.14.6.7.5 Unavoidable Adverse Impacts. Unavoidable adverse impacts resulting from the MCATC Alternative would be the same as those described for the Proposed Action.

3.14.6.8 MCAT Alternative

Visual impacts resulting from the construction and operation of the MCAT Alternative differ from the MCATC Alternative in that the Mapleton, Salem, South Field, and Lateral 20 distribution pipelines would not be constructed and segments of the SU2, SU3, and SU4 pipelines would not replace segments of the High Line Canal. The impacts identified for the Proposed Action and MCATC Alternative that relate to these distribution systems would not occur as a result of the MCAT Alternative. With this exception, the visual impacts of and mitigation for the MCAT Alternative would be identical to those discussed for the MCATC Alternative. These impacts are summarized in Section 3.14.6.10.

3.14.6.9 No Action Alternative

Under the No Action Alternative, the visual impacts would be those resulting from completing the Diamond Fork System with the construction of Three Forks Dam and Reservoir, as well as the construction of the pipeline to connect the upper end of the existing Diamond Fork Pipeline with Three Forks Dam. Three Forks Dam would be constructed directly downstream of Three Forks. All visual impacts would occur in the Uinta National Forest.

3.14.6.9.1 Uinta National Forest. The construction of Three Forks Dam and Reservoir would alter the visual character of Diamond Fork Canyon at Three Forks. Visual impacts during construction would be very limited; public access through Diamond Fork Canyon between Monks Hollow and Diamond Fork Canyon upstream of Three Forks would be limited to a brief period each day and the construction area would not be visible from Monks Hollow. After construction, the narrow paved Diamond Fork Road past Three Forks would be restored to provide the vehicular access to upper Diamond Fork Canyon that it currently provides. The visual character of Three Forks would be changed from branching creek bottoms to a small reservoir along the paved road.

3.14.6.9.2 Mitigation. Construction disturbance in Diamond Fork Canyon would be restored to promote natural revegetation.

3.14.6.9.3 Unavoidable Adverse Impacts. Completion of the Diamond Fork System with Three Forks Dam and Reservoir would alter a limited vista in Diamond Fork Canyon at Three Forks.

3.14.6.10 Summary of Impacts

A summary of impacts for the Proposed Action and the MCAPW-DFT, MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives is shown in Table 3.14-1. Generally, the Proposed Action and all the alternatives would have some significant impacts on visual resources.

3.14.6.11 Cumulative Impacts

The visual impacts associated with the SFN System would extend linearly from within Diamond Fork Canyon, through the lower portion of Spanish Fork Canyon, and along the foothills to Nephi. Cumulatively, these impacts would generally blend in with previous land disturbance ranging from roads to major farm land, towns, and subdivision development along the Wasatch Front. Because of the extent of previous development, future projects considered cumulatively with the SFN System would not be considered significant. The future Diamond Fork and Sixth Water Creek Restoration Plans should have little visual impact in the Diamond Fork drainage above the future baseline. The Western Transportation Corridor expansion may have a significant visual impact, but this impact would likely occur far west of the Main Conveyance Aqueduct and not be directly tied to it.

Table 3.14-1
Summary of Impacts to Visual Resources

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Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action				
Construction Impacts				
Tanner Ridge Tunnel inlet	Visible to occasional hikers and horseback riders.	Not significant	None	Not significant
Tanner Ridge Tunnel outlet, Diamond Fork Siphon, Red Mountain Tunnel inlet, and access roads	Land disturbance noticeable during construction; after restoration, only access roads partially visible.	Significant	None	Significant
Red Mountain Tunnel outlet, Red Hollow Pipeline, and access roads	Would not be visible to public.	Not significant	None	Not significant
Pressure-reducing station at end of Red Hollow Pipeline	Localized land disturbance noticeable during construction; concrete valve structure after construction.	Not significant	None	Not significant
Southeastern Utah Valley	Disturbed land would be visible.	Not significant	None	Not significant
Spanish Fork Canyon and along I-15 in eastern Juab County	Land disturbance would be visible for several miles of travel.	Significant	None	Significant
West Mona Pumping Plant	Would not be noticeable to the average viewer.	Not significant	None	Not significant
Nephi Pumping Plant	Would dominate the view in the neighborhood.	Significant	None	Significant
Regulating ponds, equalization reservoirs, and Main Conveyance Reservoir	These facilities would alter the characteristics of the visual setting within their immediate vicinity.	Not significant	None	Not significant
Salt Creek Diversion Dam	Would not dominate the surrounding visual characteristics.	Not significant	None	Not significant
Salt Creek west of Nephi	Would alter the visual characteristics of the area.	Significant	Tree saplings would be provided at no cost to affected residences.	Significant
Ironworks shop in Nephi	Not visible to a large number of viewers.	Not significant	None	Not significant
Existing canals	Would not affect a large number of viewers.	Not significant	None	Not significant
Operation Impacts				
Recreation trail	There are a few locations from which trail use could be viewed.	Not significant	None	Not significant

Table 3.14-1
Summary of Impacts to Visual Resources

Page 2 of 2

Resources	Impact	Significance	Mitigation	Significance After Mitigation
MCAP Alternative				
Monks Hollow Dam and Reservoir	Would reduce visual quality of Diamond Fork Canyon at Monks Hollow.	Significant	None	Significant
Upper Diamond Fork Canyon	Motorized access from lower Diamond Fork Road would be terminated.	Significant	None	Significant
Effects on southern Utah Valley, Spanish Fork Canyon, and the I-15 corridor in eastern Juab County would be the same as for the Proposed Action.				
MCAPW Alternative				
Same as MCAP Alternative except for construction of a turnout at the end of the Diamond Fork Pipeline, and the recreation trail would not be built.				
MCATC Alternative				
Same as MCAP Alternative except that the recreation trail would not be built.				
MCAT Alternative				
Same as MCATC Alternative except that the South Field and Mapleton distribution pipelines would not be constructed.				
No Action Alternative				
Diamond Fork Canyon	Three Forks Dam would change the view at the dam site, but would not dominate the surrounding viewshed.	Not significant	None	Not significant
Upper Diamond Fork Canyon	Three Forks Dam would block motorized access from lower Diamond Fork Canyon.	Significant	None	Significant

3.15 Transportation

3.15.1 Introduction

This section addresses potential impacts to transportation resources from the construction, operation, and maintenance of the SFN System and related actions.

3.15.2 Issues Addressed in the Impact Analysis

The following issues are addressed in the impact analysis:

- Potential disruption of traffic flow resulting from construction activities
- Potential traffic increases as a result of the construction, operation, and maintenance of the SFN System and associated features

3.15.3 Description of Impact Area of Influence

The impact area of influence for transportation resources includes all major and minor transportation networks within southern Utah and eastern Juab Counties. These transportation corridors include railroads, highways, local surface streets, and USFS roads within the Uinta National Forest.

3.15.4 Affected Environment

The affected environment includes the major and minor roads that would be used during construction, operation, and maintenance of the SFN System, as well as roadways, railroads, or waterways that would be crossed by either SFN System pipelines or associated facilities. Tables 1-21 and 1-43 in Chapter 1 summarize the major roadway, railroad, and waterway crossings, as well as crossing methods that would be used for construction of the SFN System.

With the exception of major roadways, such as I-15, Highway 6, and State routes, these existing transportation networks in southern Utah and eastern Juab Counties are generally unimproved because of the rural nature of these areas. Local roadways typically consist of paved secondary one- and two-lane roads. These local roadways primarily carry local residents; traffic congestion does not usually occur. Two paved roads are located within the Diamond Fork drainage area. Both of these roads, Rays Valley Road and Diamond Fork Road, enter the Uinta National Forest from Highway 6. Additionally, a number of dirt and gravel roads are located in the area. These roads are used primarily by the public to access Uinta National Forest for recreational purposes. Certain public and private land management personnel also use these roads.

Major roads that would be used during construction of the SFN System include I-15, Highway 6, and State Routes (SR) 89, 41, 132, and 28. Recent Average Annual Daily Traffic (AADT) counts for intersections in the impact area of influence are shown in Table 3.15-1. These intersections would be used to access facilities associated with the SFN System and related actions. A number of lesser-traveled roads would also be used for construction and maintenance activities; however, specific roads and routes to be traveled have not been determined and AADT volumes are not available.

Affected railroad corridors in the impact area of influence are the Denver and Rio Grande Western Railroad, Utah Railroad, and Union Pacific Railroad. Within the impact area of influence, the Denver and Rio Grande Western and Utah Railroads run through Spanish Fork Canyon. The Union Pacific Railroad runs north/south through eastern Juab County and, in Nephi, is located along the western edge of the city.

Table 3.15-1
Average Annual Daily Traffic Counts at Intersections Within the SFN System Impact Area of Influence

Location	Average Annual Daily Traffic (number of vehicles)
Southern Utah County	
I-15 at Spanish Fork	37,215
I-15 Payson Interchange	25,745
I-15 Santaquin Interchange	16,635
Highway 6 at I-15, Santaquin	6,060
Highway 6 south of Payson	4,820
Highway 6 at SR 115 in Payson	6,315
Highway 6 at west edge of Salem	6,475
Highway 6 at east Spanish Fork	1,755
Highway 6 at SR 214	5,825
Highway 6 at Moark Junction	7,875
Highway 6 at SR 89 Thistle	5,510
I-15 south of Santaquin	13,940
Highway 6 at Rays Valley Road	5,510*
Highway 6 at Diamond Fork Canyon Road	5,510*
Eastern Juab County	
I-15 Mona Interchange	13,830
I-15 North Nephi Interchange	13,830
I-15 South Nephi Interchange	9,320
SR 132 in Nephi	4,300
SR 28 south of I-15	3,210

Source: Perry 1995
*It was assumed that the AADT is similar to Highway 6 at SR 89 at Thistle.

3.15.5 Impact Analysis

3.15.5.1 Significance Criteria

The following transportation impacts would be considered significant if construction, operation, or maintenance activities associated with the SFN System would result in one or more of the following:

- An increase in AADT volumes of 10 percent or more for selected major roadways
- Vehicular travel delays of more than 15 minutes

- Rerouting of emergency response vehicles or normal traffic patterns
- Accelerated roadway deterioration and increased maintenance costs and/or required upgrading of roadways or capital expenditures to mitigate vehicle flow and/or safety deficiencies that are beyond the plans or fiscal capabilities of the agency maintaining the road.

These criteria are based upon discussions with traffic engineers from the UDOT and Utah and Juab Counties, review of common traffic practices, and professional judgement.

3.15.5.2 Potential Impacts Eliminated from Further Analysis

Potential physical impacts on local roads from heavy equipment and other construction-related traffic were eliminated from further analysis. As stated in Appendix B, *Standard Operating Procedures*, any physical damage to local roads from construction equipment or other activities would be repaired concurrently with construction activities, and no permanent physical impacts would occur.

3.15.5.3 Proposed Action

3.15.5.3.1 Impacts. The following sections describe construction- and operation-related impacts that could result from the Proposed Action.

3.15.5.3.1.1 Construction-Related Traffic Impacts. Construction-related traffic would be associated with worker commuter traffic and the delivery of equipment and steel liner plates, pipe, and other material. The pipe for both the "Diamond Fork Tunnel Alternative" and the Main Conveyance Aqueduct would be shipped from the manufacturer by rail and/or truck to the construction site in lengths up to 40 feet.

Estimated peak construction-related traffic volumes at major intersections and roadways in the impact area of influence are identified in Table 3.15-2 by construction segment and peak number of trips per day. The total number of trips for each construction segment includes general construction equipment as well as special equipment necessary for such activities as crossing roadways and constructing reservoirs and pumping plants.

Traffic resulting from construction workers commuting to and from construction sites is included in the total number of trips and is estimated to be between 20 and 30 persons per day for each segment. As discussed in Section 3.12, Socioeconomics, construction workers are expected to come from southern Utah, eastern Juab, and Salt Lake Counties. The assumed travel route for Salt Lake County workers would be generally south on I-15 to specific construction segments. For the purposes of this analysis, 30 persons per day (or 60 trips) are assumed in order to assess the impacts on traffic at major intersections. Fifteen workers per day are assumed for construction of the recreation trail.

A summary of construction-related traffic by percentage of increase for major intersections is presented in Table 3.15-3. These percentages were determined by estimating AADT volumes for the year 2005 using 1994 AADT volumes. (The year 2005 was used to determine traffic increases because it is the year that the Main Conveyance Reservoir is scheduled to be constructed and is considered to be the peak construction year.) The total estimated construction-related trips were then divided by the AADT volumes for the year 2005 to determine the percentage of increase in AADT for specified intersections.

Table 3.15-2
Estimated Construction Traffic by Construction Segment for the Proposed Action and MCAPW-DFT Alternative

Construction Segment[a]	Construction Duration (no. of work days)	Maximum Number of Trips per Day[a]	Transportation Route to Segment
Diamond Fork Aqueduct Facilities			
"Diamond Fork Tunnel Alternative"	1,342	416	I-15 east to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to USFS Road #622.
Spanish Fork Pipeline	250	158	I-15 to Highway 6, east on Highway 6 toward confluence of Diamond Fork Creek and Spanish Fork River.
Snell Canyon Pipeline	200	156	I-15 to Highway 6 to Powerhouse Road.
Salem Bench Pipeline	250	104	I-15 south to Main Street exit of Spanish Fork/Payson.
Payson Pipeline	250	100	I-15 south to Main Street exit in Payson.
Santaquin Pipeline	220	106	I-15 south to Santaquin to South Santaquin Interchange or Highway 6.
Mona Pipeline	250	208	I-15 south to Mona Interchange.
Juab Pipeline	200	102	I-15 south to North Nephi Interchange.
Nephi Pipeline	250	118	I-15 south to SR 132/South Nephi Interchange.
West Mona Facilities	260	100	I-15 south to Mona Interchange.
Recreation Trail[b,c]	100	12	I-15 south to Highway 6 to Salem Bench Pipeline segment.

[a]Assumes related turnouts and regulating ponds would be constructed concurrently with related segments.
[b]Recreation trail numbers refer only to paving of trail. All other construction-related activities have already been accounted for in the appropriate construction segment trip numbers.
[c]The recreation trail would only be constructed under the Proposed Action.

As indicated in Table 3.15-3, increases to AADT resulting from construction trips could increase the estimated AADT volumes by more than 10 percent at one intersection. AADT increases of up to 20 percent would be possible on Highway 6 at east Spanish Fork. This increase would result from an estimated maximum of 416 construction-related traffic trips per day through this intersection. While construction of the "Diamond Fork Tunnel Alternative" would take a number of years, this peak would only occur during the few months when two segments of the pipeline could be under construction concurrently. A 20 percent increase in traffic volumes at this intersection could result in possible traffic delays. This would be a significant, short-term impact to transportation resources. No other increases in traffic volumes would have a significant impact on transportation resources under the Proposed Action.

Table 3.15-3
Summary of Construction-Related Traffic Impacts Resulting from the Proposed Action

Page 1 of 2

Location	Construction Segment	Baseline AADT (1994)	Projected AADT (2005)	Estimated No. of Construction-Related Trips	% of Increase
I-15 at Spanish Fork	"Diamond Fork Tunnel Alternative"	37,215	47,700	416	<0.9 %
	Spanish Fork			158	
	Snell			156	
	Salem			104	
	Santaquin			106	
	Mona			208	
	Juab			102	
	Nephi			118	
	West Mona			100	
I-15 Payson Interchange	Payson	23,985	33,300	100	< 0.5 %
	Santaquin			106	
	Mona			208	
	Juab			102	
	Nephi			118	
	West Mona			100	
I-15 Santaquin Interchange	Santaquin	16,635	21,900	106	< 1 %
	Mona			208	
	Juab			102	
	Nephi			118	
	West Mona			100	
Highway 6 at I-15 Santaquin	Santaquin	6,060	7,150	106	< 3%
	Mona			208	
	Juab			118	
	Nephi			118	
	West Mona			100	
Highway 6 south of Payson	Payson	4,820	5,700	100	< 2 %
Highway 6 at SR 115 in Payson	Payson	6,314	7,450	100	< 2 %
Highway 6 at west edge of Salem	Salem	6,475	7,600	104	< 2 %

Table 3.15-3
Summary of Construction-Related Traffic Impacts Resulting from the Proposed Action
Page 2 of 2

Location	Construction Segment	Baseline AADT (1994)	Projected AADT (2005)	Estimated No. of Construction-Related Trips	% of Increase
Highway 6 at east Spanish Fork	"Diamond Fork Tunnel Alternative"	1,755	2,100	416	<20 %
	Spanish Fork			158	< 8 %
	Snell			156	< 8 %
Highway 6 at SR 214	"Diamond Fork Tunnel Alternative"	5,185	10,150	416	< 4 %
	Spanish Fork	5,825	10,150	158	< 2 %
	Snell			156	< 2 %
Highway 6 at Moark Junction	"Diamond Fork Tunnel Alternative"	7,875	13,700	416	< 3 %
	Spanish Fork			156	< 2 %
	Snell			156	< 2 %
Highway 6 and SR 89 at Thistle	"Diamond Fork Tunnel Alternative"	5,510	9,600	416	< 5 %
	Spanish Fork			156	< 2 %
I-15 south of Santaquin	Santaquin	13,940	18,700	106	< 1 %
	Mona			208	< 2 %
	Juab			102	< 1 %
	Nephi			118	< 1 %
	West Mona			100	< 1 %
I-15 Mona Interchange	Mona	13,830	11,645	208	< 2 %
	Juab			102	< 1 %
	Nephi			118	< 2 %
	West Mona			100	< 1 %
I-15 North Nephi Interchange	Nephi	13,830	9,120	118	< 2 %
I-15 South Nephi Interchange	Nephi	9,320	7,920	118	< 2 %
SR 132 in Nephi	Salt Creek	4,300	3,960	118	< 4 %
SR 28 south of I-15	Nephi	3,210	2,110	118	< 6 %

3.15.5.3.1.2 ***Construction Impacts***. Open trench construction in roadways would involve closing one lane at a time and/or temporary road detours to road shoulders or other roads, covering open trenches in roadways with steel plating, and scheduling some construction activities during off-peak traffic hours. Implementation of these

procedures would result in temporary delays of less than 15 minutes, except along one portion of Highway 6, as discussed below. Blasting is not likely to be necessary; however, should the need arise, maximum delay time for local traffic is not expected to be greater than 15 minutes because of the limited area that would be affected. Based on the construction procedures identified in Chapter 1 for railroad crossings, railroad service would not be interrupted during construction, operation, or maintenance activities.

The rerouting of emergency service equipment would not be necessary because, as identified above, procedures would be implemented during construction to maintain traffic flows on roadways where construction would occur by including temporary road detours to the shoulder of the road and covering open trenches in roadways with steel plating.

Construction activities associated with the "Diamond Fork Tunnel Alternative" between Monks Hollow and Springville Crossing would result in the daily restriction of public access to approximately 5 miles of Diamond Fork Road during construction of the Tanner and Red Mountain Tunnels and the Diamond Fork Siphon. Public access to the Diamond Fork area via Diamond Fork Road would be allowed twice daily for land management personnel and recreational access, but access would be limited throughout most of the day. This would be a significant adverse impact to transportation resources. Emergency vehicle access to the Diamond Fork drainage would be accommodated throughout the day, as necessary.

During construction of the "Diamond Fork Tunnel Alternative," Diamond Fork Road to USFS Road #622 would be restored and improved (widened and repaved) to a condition better than currently exists. This would be a beneficial impact to transportation resources.

Along Highway 6 just west of Pole Canyon, construction of the Spanish Fork Pipeline may result in delays of up to 30 minutes because of the lack of adequate work space to accommodate single-lane closure or shoulder detours. This impact is considered significant and unavoidable.

Impacts associated with construction of the recreation trail would be related primarily to the paving of the trail following completion of the Main Conveyance Aqueduct and would not be significant.

3.15.5.3.1.3 Operation Impacts. Minimal maintenance is required for a pressurized water pipeline built to current standards. Repairs usually require a minimum amount of excavation and heavy equipment. Other minor repairs include correction of erosion, maintenance of erosion checks, replacement of pipeline markers, and removal of debris from the right-of-way. Traffic resulting from the operation of the SFN System is expected to be minimal and only required for periodic activities such as visiting the pumping plants and checking gauges. Because of the infrequent nature of operation and maintenance activities, potential transportation impacts resulting from increases in traffic required by operation activities would be insignificant.

Traffic impacts associated with the use of the recreation trail are expected to be less than significant because of the availability of three parking facilities along the trail, the rural nature of the area, and the low estimated traffic volumes in the vicinity. Beneficial impacts to transportation resources as a result of the recreation trail would be insignificant. The trail would be utilized as a non-motorized transportation route by a limited number of people and, thus, would not significantly alter motorized transportation traffic patterns.

3.15.5.3.1.4 Related Actions (Local Development). Transportation impacts associated with the distribution and on-farm systems would result primarily from construction-related activities. While increases in traffic volumes cannot be accurately quantified, the limited lengths of new pipeline to be constructed over a relatively long period of time (approximately 5 to 10 years) would result in minimal traffic-related impacts and would, therefore, not be significant.

3.15.5.3.2 Mitigation. No mitigation measures would be undertaken for possible traffic delays of up to 30 minutes on Highway 6 in Spanish Fork Canyon. During construction in this area, efforts would be made to limit traffic delays to the extent practicable.

To help alleviate inconveniences related to the closure of Diamond Fork Road, the CUWCD would post signs along Highway 6 at Diamond Fork Road to notify the public of the closure and times of permitted access. Additionally, notices of the closure would be placed in local newspapers prior to and throughout the duration of construction in the Diamond Fork drainage.

3.15.5.3.3 Unavoidable Adverse Impacts. Potential traffic volume increases of up to 20 percent on Highway 6 at east Spanish Fork would be an unavoidable adverse impact. Traffic delays along Highway 6 in Spanish Fork Canyon and the potential daily closure of Diamond Fork Road during the construction of the "Diamond Fork Tunnel Alternative" are considered unavoidable adverse impacts associated with the Proposed Action.

3.15.5.4 MCAPW-DFT Alternative

3.15.5.4.1 Impacts. Impacts resulting from the MCAPW-DFT Alternative would be similar to those described for the Proposed Action. Under the MCAPW-DFT Alternative, the Main Conveyance Aqueduct would not replace the High Line Canal, but would be routed along the canal between Spanish Fork and Santaquin. However, construction, operation, and maintenance activities would result in the same project-related traffic as identified for these areas under the Proposed Action. Additionally, the recreation trail would not be constructed under the MCAPW-DFT Alternative; therefore, no transportation impacts as a result of recreation trail construction would occur.

3.15.5.4.2 Related Actions (Local Development). Under the MCAPW-DFT Alternative, construction of distribution pipelines as an aspect of related actions would be greatly reduced; thus, any transportation impacts resulting from distribution pipeline construction would be similarly reduced.

3.15.5.4.3 Mitigation. Mitigation measures undertaken to alleviate transportation impacts under the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action.

3.15.5.4.4 Unavoidable Adverse Impacts. Unavoidable impacts associated with the MCAPW-DFT Alternative would be the same as those identified for the Proposed Action.

3.15.5.5 MCAP Alternative

3.15.5.5.1 Impacts. Transportation impacts associated with the MCAP Alternative would be similar to those described for the Proposed Action. However, under this alternative, the "Diamond Fork Tunnel Alternative" would not be constructed. Instead, Monks Hollow Dam and Reservoir would be built. This section discusses impacts associated with the construction of Monks Hollow Dam and Reservoir. The impacts resulting from the construction of the Main Conveyance Aqueduct would be the same as those described for the Proposed Action.

Transportation impacts resulting from the construction and operation of Monks Hollow Dam and Reservoir were addressed in the *Final Environmental Impact Statement* (USBR 1984) and *Final Supplement to FEIS, Diamond Fork System* (USBR 1990). The transportation impacts identified in the Diamond Fork System documents are incorporated into the following sections.

3.15.5.5.1.1 Construction Traffic Impacts. During construction of Monks Hollow Dam and Reservoir, construction traffic would utilize Diamond Fork Road to access the Monks Hollow area. Construction vehicles and equipment would be required to clear portions of the reservoir basin and construct the dam. A summary of the construction traffic volumes expected under the MCAP Alternative during construction within the Diamond

Fork drainage is provided in Table 3.15-4. Construction vehicles would access the Diamond Fork drainage via Highway 6 and then either Diamond Fork Road or Rays Valley Road. Both Rays Valley Road and Diamond Fork Road experience very limited traffic, and the additional construction-related traffic would result in a significant increase in traffic along these roads.

Table 3.15-4
Estimated Construction Traffic in the Diamond Fork Drainage Under the MCAP, MCAPW, MCATC, and MCAT Alternatives

Project Feature	Construction Duration (no. of work days)	Maximum Number of Trips per Day	Transportation Route to Segment
Monks Hollow Dam and Reservoir*	805	1,300	I-15 east to Highway 6; Highway 6 to Diamond Fork Road to Monks Hollow.

*Includes Diamond Fork Pipeline Extension

Potential increases to traffic volumes at intersections affected by construction-related traffic are shown in Table 3.15-5. Potential AADT increases of more than 10 percent could occur at three intersections during the construction of Monks Hollow Dam and Reservoir. Most notably, Highway 6 at east Spanish Fork could experience traffic increases of up to 62 percent. Each of these increases could result in potential traffic delays at the identified intersections during some portions of the construction period. This would be a significant, short-term impact to transportation resources.

Table 3.15-5
Summary of Construction-Related Traffic Impacts Resulting from Construction in the Diamond Fork Drainage Under the MCAP, MCAPW, MCATC, and MCAT Alternatives

Location	Baseline AADT (1994)	Projected AADT (2005)	Estimated No. of Construction-Related Trips	Percentage of Increase
I-15 at Spanish Fork	37,215	47,700	1,300	< 3 %
Highway 6 at east Spanish Fork	1,755	2,100	1,300	< 62 %
Highway 6 at SR 214	5,825	10,150	1,300	<13 %
Highway 6 at Moark Junction	7,875	13,700	1,300	<10 %
Highway 6 and SR 89 at Thistle	5,510	9,600	1,300	<14 %

3.15.5.5.1.2 Construction Impacts. Construction activities within the Diamond Fork drainage would result in the daily restriction of public access to Diamond Fork Road during the construction period for Monks Hollow Dam. Public access to the Diamond Fork drainage via Diamond Fork Road would be allowed twice daily for land management personnel and recreational access, but access would be limited throughout most of the day. Emergency vehicle access would be accommodated throughout the day, as necessary. Diamond Fork Road would be permanently closed to public access just below Monks Hollow Dam. This closure would be a significant adverse transportation impact.

3.15.5.5.1.3 Operation Impacts. As a result of the construction of Monks Hollow Dam and Reservoir, Diamond Fork Road would be permanently closed to through traffic at Monks Hollow Dam. A new road would be

constructed to provide access to the reservoir and a day-use area on the northwest side of the dam. Following closure of Diamond Fork Road, public access to the Diamond Fork drainage above the reservoir would be primarily achieved by using Rays Valley Road. Both the closure of Diamond Fork Road at Monks Hollow and the traffic-shift effect to Rays Valley Road would be significant impacts to transportation resources in the Diamond Fork drainage.

3.15.5.5.2 Related Actions (Local Development). Transportation impacts resulting from related actions under the MCAP Alternative would be the same as those identified for the Proposed Action.

3.15.5.5.3 Mitigation Measures. Mitigation measures under the MCAP Alternative would be the same as those identified for the Proposed Action, with the following additional measure. To alleviate impacts associated with the permanent closure of Diamond Fork Road at Monks Hollow, the CUWCD would be responsible for posting and maintaining signs at Diamond Fork Road indicating that Diamond Fork Road does not continue beyond Monks Hollow Reservoir.

3.15.5.5.4 Unavoidable Impacts. Unavoidable impacts associated with the MCAP Alternative would be the same as those identified under the Proposed Action. Potential traffic volume increases of greater than 10 percent at three intersections would be an unavoidable impact during construction of Monks Hollow Dam and Reservoir. Additionally, the permanent closure of Diamond Fork Road and the added traffic on Rays Valley Road would not be completely alleviated by the mitigation measures described above and are considered unavoidable impacts.

3.15.5.6 MCAPW Alternative

3.15.5.6.1 Impacts. Transportation impacts associated with the MCAPW Alternative would the same as those described for the Diamond Fork drainage under the MCAP Alternative (i.e., resulting from the development of Monks Hollow Dam and Reservoir) and similar to those described for the Proposed Action Main Conveyance Aqueduct. Under the MCAPW Alternative, the Main Conveyance Aqueduct would not replace the High Line Canal, but would be routed along the canal between Spanish Fork and Santaquin. However, construction, operation, and maintenance activities would result in the same project-related traffic as identified for these areas under the Proposed Action. Additionally, there would be no recreation trail constructed under the MCAPW Alternative; therefore, there would be no transportation impacts as a result of recreation trail construction.

3.15.5.6.2 Mitigation. Mitigation undertaken to alleviate impacts associated with the MCAPW Alternative would be the same as that identified for the Proposed Action, with the addition of the mitigation measures described for the MCAP Alternative.

3.15.5.6.3 Unavoidable Impacts. Unavoidable impacts associated with the MCAPW Alternative would be the same as those identified for the Proposed Action and the MCAP Alternative.

3.15.5.7 MCATC Alternative

3.15.5.7.1 Impacts. Impacts within the Diamond Fork drainage associated with the MCATC Alternative would be the same as those identified for the MCAP Alternative. Impacts associated with the MCATC Alternative Main Conveyance Aqueduct would be similar to those described for the Proposed Action Main Conveyance Aqueduct, with the exception of some differences in construction segments and possible minor differences in distribution system-related traffic. Access and use of minor roadways during construction of the Loafer Mountain, Tithing Mountain, and Dry Mountain Tunnels would be required. The recreation trail would not be constructed under this alternative.

Estimated peak construction-related traffic volumes at major intersections are identified by construction segment and peak number of trips per day in Table 3.15-6. Construction segment locations and the peak number of trips

per day for the MCATC Alternative differ slightly from those described for the Proposed Action Main Conveyance Aqueduct. Because similar numbers of construction workers are expected to take the same route to the general construction area, the Proposed Action and MCATC Alternative would have similar construction-related traffic impacts.

Table 3.15-6
Estimated Construction Traffic for the MCATC and MCAT Alternatives, Main Conveyance Aqueduct Pipeline Segments

Construction Segment	Construction Duration (no. of work days)	Maximum Number of Trips per Day	Transportation Route to Segment
Spanish Fork Pipeline	250	156	I-15 to Highway 6, east on Highway 6 toward confluence of Diamond Fork Creek and Spanish Fork River
Loafer Mountain Tunnel	840	138	I-15 to Highway 6 to Powerhouse Road
Salem Bench Pipeline	250	100	I-15 south to Main Street exit of Spanish Fork/Payson
Tithing Mountain Tunnel and Peteetneet Pipeline	110	140	I-15 to SR 115 to Highway 6
Dry Mountain Tunnel	340	138	I-15 to SR 115 to Highway 6
Santaquin Pipeline	220	108	I-15 south to Santaquin to South Santaquin Interchange/ Highway 6
Mona Pipeline	250	208	I-15 south to Mona Interchange to Couch Canyon Road
Juab Pipeline	200	102	I-15 south to North Nephi Interchange
Nephi Pipeline	250	118	I-15 south to North/Central/South Nephi Interchange
West Mona Facilities	250	100	I-15 south to Mona Interchange

3.15.5.7.2 Mitigation. Mitigation undertaken to alleviate impacts associated with the MCATC Alternative would be the same as those identified for the Proposed Action, with the addition of the mitigation described for the MCAP Alternative.

3.15.5.7.3 Unavoidable Adverse Impacts. Unavoidable impacts associated with the MCATC Alternative would be the same as those identified for the Proposed Action and the MCAP Alternative.

3.15.5.8 MCAT Alternative

3.15.5.8.1 Impacts. Impacts within the Diamond Fork drainage associated with the MCAT Alternative would be the same as those identified for the MCAP Alternative. Impacts associated with the MCAT Main Conveyance Aqueduct would be similar to those described for the Proposed Action Main Conveyance Aqueduct, with the exception of some differences in construction segments and significant reductions in the extent of distribution system development and associated traffic impacts. Access and use of minor roadways during construction of the Loafer Mountain, Tithing Mountain, and Dry Mountain Tunnels would be required. The recreation trail would not be constructed under this alternative.

Development of related actions would be less extensive under the MCAT Alternative than under the MCATC Alternative; thus, no significant transportation impacts would occur.

3.15.5.8.2 Mitigation. Mitigation measures undertaken to alleviate impacts associated with the MCAT Alternative would be the same as those identified for the Proposed Action, with the addition of the mitigation measures described for the MCAP Alternative.

3.15.5.8.3 Unavoidable Adverse Impacts. Unavoidable impacts associated with the MCAT Alternative would be the same as those identified for the Proposed Action and the MCAP Alternative.

3.15.5.9 No Action Alternative

3.15.5.9.1 Impacts. Potential transportation impacts of the No Action Alternative would result from the construction of Three Forks Dam and Reservoir and the Diamond Fork Pipeline extension. Construction-related traffic expected during the construction of these facilities is summarized in Table 3.15-7. Construction-related traffic impacts resulting from the No Action Alternative would be less significant than those identified for the MCAP Alternative in the Diamond Fork drainage.

Table 3.15-7
Estimated Construction Traffic for the No Action Alternative

Construction Segment	Construction Duration (no. of work days)	Maximum Number of Trips per Day	Transportation Route to Segment
Three Forks Dam and Reservoir	793	600	I-15 east to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to Three Forks.

Potential increases to traffic volumes at intersections affected by construction-related traffic are shown in Table 3.15-8. Potential AADT increases of more than 10 percent could occur at one intersection during the construction of Three Forks Dam and Reservoir. A potential 30 percent increase of traffic volumes on Highway 6 in east Spanish Fork could cause delays. This would be a significant impact to transportation resources.

Table 3.15-8
Summary of Construction-Related Traffic Impacts Resulting from Construction in the Diamond Fork Drainage Under the No Action Alternative

Location	Baseline AADT (1994)	Projected AADT (2005)	Estimated No. of Construction-Related Trips	% of Increase
I-15 at Spanish Fork	37,215	47,700	600	< 2 %
Highway 6 at east Spanish Fork	1,755	2,100	600	< 30 %
Highway 6 at SR 214	5,825	10,150	600	< 6 %
Highway 6 at Moark Junction	7,875	13,700	600	< 5 %
Highway 6 and SR 89 at Thistle	5,510	9,600	600	< 7 %

Construction activities required for the development of Three Forks Dam and Reservoir would result in the daily restriction of public access on Diamond Fork Road during the construction period. Public access to the Diamond Fork drainage via Diamond Fork Road would be allowed twice daily for land management personnel and

recreational access, but access would be limited throughout most of the day. This would be a significant adverse impact.

Local development of M&I distribution systems could result in minor traffic delays on local roadways, but would not cause a significant impact.

3.15.5.9.2 Mitigation. To help alleviate impacts associated with the restricted access on Diamond Fork Road, the CUWCD would be responsible for posting and maintaining signs indicating times of allowable public access.

3.15.5.9.3 Unavoidable Adverse Impacts. Unavoidable impacts associated with the No Action Alternative would result from the temporary restriction of access on Diamond Fork Road and potential traffic increases of up to 30 percent on Highway 6 in east Spanish Fork.

3.15.6 Summary of Impacts

Transportation impacts from the Proposed Action and each of the alternatives are summarized in Table 3.15-9.

Table 3.15-9
Summary of Impacts to Transportation Resources

Page 1 of 2

Location	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action and MCAPW-DFT Alternative				
Highway 6 at east Spanish Fork	Potential AADT increases up to 20 percent.	Significant	None	Significant
Highway 6 in Spanish Fork Canyon, adjacent to Pole Canyon	Potential traffic delays of up to 30 minutes.	Significant	None	Significant
Diamond Fork Road	Daily restrictions to public access to Diamond Fork Road during construction of Diamond Fork Aqueduct.	Significant	Signage and public notices of closure dates and times.	Significant
MCAP and MCAPW Alternatives				
Three intersections utilized by construction-related traffic	Potential AADT increases of up to 62 percent.	Significant	None	Significant
Highway 6 in Spanish Fork Canyon, adjacent to Pole Canyon	Potential traffic delays of up to 30 minutes.	Significant	None	Significant
Diamond Fork Road	Daily restrictions to public access to Diamond Fork Road during construction of Monks Hollow Dam and Reservoir.	Significant	Signage and public notices of closure dates and times.	Significant

Table 3.15-9 Summary of Impacts to Transportation Resources Page 2 of 2				
Location	**Impact**	**Significance**	**Mitigation**	**Significance After Mitigation**
Diamond Fork Road	Construction of Monks Hollow Dam and Reservoir would result in permanent closure of Diamond Fork Road at Monks Hollow.	Significant	Signs would be placed on Diamond Fork Road to notify the public that Diamond Fork Road does not continue beyond Monks Hollow Reservoir.	Significant
Rays Valley Road	With the permanent closure of Diamond Fork Road, public traffic entering Uinta National Forest would increase on Rays Valley Road.	Significant	None	Significant
MCATC and MCAT Alternatives				
Three intersections utilized by construction-related traffic.	Potential AADT increases of up to 62 percent.	Significant	None	Significant
Diamond Fork Road	Daily restrictions to public access to Diamond Fork Road during construction of Monks Hollow Dam and Reservoir.	Significant	Signage and public notices of closure dates and times.	Significant
Diamond Fork Road	Construction of Monks Hollow Dam and Reservoir would result in permanent closure of Diamond Fork Road at Monks Hollow.	Significant	Signs would be placed on Diamond Fork Road to notify the public that the road does not continue beyond Monks Hollow Reservoir.	Significant
Rays Valley Road	With the permanent closure of Diamond Fork Road, public traffic entering Uinta National Forest would increase on Rays Valley Road.	Significant	None	Significant
No Action Alternative				
Highway 6 at east Spanish Fork	Potential AADT increases of up to 30 percent.	Significant	None	Significant
Diamond Fork Road	Daily restrictions to public access to Diamond Fork Road during construction of Three Forks Dam and Reservoir.	Significant	Signage and public notices of closure dates and times.	Significant

3.15.7 Cumulative Impacts

Section 1.8 identifies projects to be considered for cumulative impacts associated with both their development and the development of the SFN System. Because of the limited geographical aspects of transportation impacts

associated with the SFN System, it has been determined that no significant cumulative impacts to transportation resources would result from construction and operation of the SFN System.

3.16 Air Quality

3.16.1 Introduction

This section addresses potential impacts to air quality as a result of the construction and operation of the SFN System and related actions. The analysis focuses on potential short- and long-term impacts and the ability to meet established air quality standards.

Air quality is defined as the concentration of various air pollutants in the atmosphere. The EPA has established NAAQS, codified in 40 CFR Part 50, for several pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), lead (Pb), and particulate matter smaller than 10 microns in diameter (PM_{10}). These standards are expressed as pollutant concentration limits and are set at levels intended to protect public health.

3.16.2 Issues Eliminated from Further Analysis

No air quality issues were eliminated from further analysis.

3.16.3 Issues Addressed in the Impact Analysis

No issues regarding air quality were raised in the public scoping process or in any agency comments.

The air quality impact analysis focuses on the following issues:

- Whether fugitive dust and gaseous emissions generated during the construction of the SFN System and related actions would cause a temporary exceedence of ambient air quality standards or interfere with the ability of Utah County to meet the PM_{10} standard

- Whether long-term operation and maintenance of the SFN System and related actions would result in any direct or indirect long-term air quality impacts

3.16.4 Description of Impact Area of Influence

The general air quality impact area of influence is located within southern Utah and eastern Juab Counties. The impacts of construction activities on air quality would be localized and limited to the general areas where construction activities would occur.

3.16.5 Affected Environment

The affected environment considered for the SFN System air quality analysis includes both climate and the existing ambient air quality within the impact area of influence. There are limited sources of data to directly characterize climate and air quality parameters within the impact area of influence. However, the available climate and meteorological data are adequate to generalize existing baseline conditions. Available ambient air quality data have been acquired for locations expected to have significantly poorer air quality than areas near SFN System features. Therefore, the use of available data results in a conservative (i.e., worst case) estimate of existing air quality within the impact area of influence.

3.16.5.1 Climate

Climate represents the long-term average weather patterns of a given area. Weather affects air quality through its impact on the dispersion of pollutants emitted into the atmosphere. In some cases, weather conditions can also affect the amount of pollutants emitted, such as fugitive dust particles blown airborne from exposed soils. The most important meteorological parameters affecting air quality are wind speed and wind direction. Wind speed and direction determine where pollutants are transported and the rate of dilution in the atmosphere. Temperature and precipitation also affect air quality through their effects on emissions, pollutant transport, atmospheric removal mechanisms, and atmospheric chemistry.

Southern Utah and eastern Juab Counties have a semiarid continental climate, with four well-defined seasons. Climate and meteorological conditions are influenced by the altitude of the area (4,200 to 7,800 feet above sea level) and the presence of the Wasatch Mountains, which rise to elevations of nearly 12,000 feet. Summers are typically hot and dry, with temperatures above 100°F occurring several days per year. Winters are cold, but generally not severe. The average annual snowfall is in the range of 60 to 70 inches, with greater snowfall occurring at higher elevations.

Precipitation is generally light in the summer and early fall. Maximum precipitation occurs during the spring, when storms originating over the Pacific Ocean reach the area more frequently than in other seasons. Summer precipitation usually results from thunderstorms, which can produce significant localized rainfall. Typically, 20 to 40 thunderstorms per year occur in the SFN System impact area of influence.

General climate parameters along the Wasatch Front are summarized in Table 3.16-1. These data are based on 30 years of historical meteorological data collection at Salt Lake City, approximately 60 miles north of the impact area of influence. The seasonal variations in temperature and precipitation in the impact area of influence are similar to those in Salt Lake City. It can be assumed that precipitation levels are somewhat higher and temperatures lower within the Diamond Fork drainage because of differences in elevation.

The Utah Department of Environmental Quality (UDEQ) Division of Air Quality collects wind speed and direction data at many of its ambient air quality monitoring locations. The North Provo station is closest to the impact area of influence. Data from this station indicate that the predominant wind direction is from the north to northeast and wind speeds are generally light (i.e., less than 8 miles per hour). Winds along the SFN System aqueducts may be significantly affected by local topography. This is particularly true in Spanish Fork Canyon and the Diamond Fork drainage where mountains affect wind patterns.

3.16.5.2 Ambient Air Quality

Ambient air quality is characterized by the atmospheric concentrations of "criteria pollutants": NO_2, SO_2, O_3, CO, PM_{10}, and Pb. NAAQS have been promulgated for these criteria pollutants and are intended to protect public health, with a margin of safety. For the purposes of air quality management, geographic areas of the country are classified as "attainment" or "nonattainment" with NAAQS. The attainment classifications for Utah and Juab Counties are shown in Table 3.16-2. All air quality standards are being met in Juab County. Utah County is designated as a nonattainment area for two pollutants: CO and PM_{10}. The PM_{10} nonattainment area includes the entire county, while the CO nonattainment area is limited to the cities of Provo and Orem.

The Federal Clean Air Act requires each state to prepare and submit to the EPA a State Implementation Plan for attainment and maintenance of NAAQS. The PM_{10} plan for Utah County was approved by the EPA on July 22, 1994, and shows an attainment date of December 31, 1994 (McNeil 1994). The CO plan was submitted to the EPA on July 13, 1994.

Table 3.16-1
Climatic Parameters

Month	Temperature (°F)		Precipitation (inches)		Mean Number of Days		Wind	
	Daily Maximum	Daily Minimum	Total Precipitation	Snowfall	Precipitation > 0.01 inch	Snow, Ice Pellets >1.0 inch	Mean Wind Speed (mph)	Prevailing Direction
January	37.4	18.5	1.27	13.5	10	4	7.7	SSE
February	45.4	23.3	1.19	9.7	9	3	8.2	SE
March	50.8	28.3	1.63	10.0	10	3	8.2	SSE
April	61.8	36.6	2.12	5.9	10	2	9.3	SE
May	72.4	44.2	1.49	0.9	8	0	9.4	SE
June	81.3	51.6	1.30	Trace	5	0	9.4	SSE
July	92.6	60.5	0.70	0.0	4	0	9.4	SSE
August	90.8	58.7	0.93	0.0	8	0	9.6	SSE
September	80.3	49.3	0.68	0.1	5	0	9.1	SE
October	66.4	38.4	1.16	1.0	6	0	8.5	SE
November	50.0	28.1	1.31	6.4	7	1	7.8	SSE
December	39.0	21.5	1.39	11.7	6	4	7.8	SSE
Annual	**63.6**	**38.2**	**15.17**	**59.2**	**88**	**18**	**8.8**	**SSE**

Source: National Oceanic and Atmospheric Administration

Table 3.16-2
Air Quality Attainment Status of Utah and Juab Counties

Pollutant	Utah County	Juab County
Nitrogen Dioxide (NO_2)	Attainment	Attainment
Sulfur Dioxide (SO_2)	Attainment	Attainment
Ozone (O_3)	Attainment	Attainment
Carbon Monoxide (CO)	Nonattainment (Provo and Orem only)	Attainment
Particulate Matter (PM_{10})	Nonattainment	Attainment
Lead (Pb)	Attainment	Attainment

Ambient air quality is monitored by the UDEQ Division of Air Quality at locations throughout the state. The monitoring station closest to the SFN System is located in northern Provo. Data from this station has been used in this analysis as a conservative estimate of the existing air quality in the impact area of influence. The actual ambient air quality in Juab County and the southern portion of Utah County is probably much better than that at the North Provo station because of the lower population density and lack of significant major emission sources.

Measured ambient data from North Provo are shown in Table 3.16-3. Since SO_2 is not measured at North Provo, the SO_2 concentrations from Salt Lake City are included in this table. The violations of the 24-hour PM_{10} standard shown in the table occurred during the years 1991 to 1993. These standard violations have consistently occurred during the winter months, as a result of a combination of very stable meteorological conditions and an increase in residential wood combustion and other emission sources. The peak 24-hour PM_{10} concentrations during the period 1990 to 1993 exceeded the federal standard during January and February. PM_{10} concentrations were at a minimum between April and October.

Table 3.16-3
Ambient Air Quality in Utah County

Station	Pollutant	Averaging Time	Highest Measured Concentrations			National Ambient Air Quality Standard
			1991	1992	1993	
North Provo	NO_2	Annual	0.023 ppm	0.019 ppm	0.025 ppm	0.05 ppm
		1-Hour	0.14 ppm (0.14 ppm)	0.093 ppm (0.066 ppm)	0.112 ppm (0.111 ppm)	
Salt Lake City	SO_2	Annual	0.007 ppm	0.007 ppm	0.006 ppm	0.03 ppm
		24-Hour	0.04 ppm (0.04 ppm)	0.089 ppm (0.073 ppm)	0.040 ppm (0.035 ppm)	0.14 ppm
		3-Hour	0.12 ppm (0.11 ppm)	0.392 ppm (0.333 ppm)	0.080 ppm (0.079 ppm)	0.5 ppm
North Provo	O_3	1-Hour	0.09 ppm (0.08 ppm)	0.096 ppm (0.089 ppm)	0.089 ppm (0.084 ppm)	0.12 ppm
North Provo	CO	8-Hour	**9 ppm** (7 ppm)	8 ppm (8 ppm)	6 ppm (6 ppm)	9 ppm
		1-Hour	13 ppm (11 ppm)	13 ppm (12 ppm)	9 ppm (9 ppm)	36 ppm
North Provo	PM_{10}	Annual	37 μg/m^3	33 μg/m^3	33 μg/m^3	50 μg/m^3
		24-Hour	**234 μg/m^3 (182 μg/m^3)**	**227 μg/m^3 (173 μg/m^3)**	**194 μg/m^3 (178 μg/m^3)**	150 μg/m^3

Note: Values in parentheses represent second highest concentration measured during the year. Values in **bold** are measured concentrations that equal or exceed standards.

The 8-hour standard for CO was equaled only once in the 3-year period (in 1991) and this has not occurred since (see Table 3.16-3). Although the Provo/Orem area is still designated nonattainment, it is likely that the area has actually been meeting the CO standards since 1992.

3.16.6 Impact Analysis

Because the SFN System would not result in any long-term emissions of airborne pollutants, this impact analysis focuses on the temporary effects of construction activities on air quality in the impact area of influence. Emissions from construction are associated with two primary sources:

- Exhaust emissions from heavy equipment operation
- Construction dust produced during site preparation, excavation, pipe installation, backfill activities, and site restoration

Presented in this section are estimates of the magnitude of these emissions and an assessment of the impact of these emissions on air quality in the impact area of influence. The potential for the air quality impacts to exceed health-based standards is also identified.

3.16.6.1 Significance Criteria

Pursuant to the Clean Air Act, the EPA has adopted NAAQS for several "criteria" pollutants. These standards are intended to protect the public health with a margin of safety. Significant air quality impacts occur when emissions from a project prevent attainment or maintenance of these health-protective standards. For the SFN System, an air quality impact would be considered significant if one of the following were to occur:

- Construction activities result in a short- or long-term violation of any ambient air quality standard
- Activities or emissions caused by growth induced by the SFN System interfere with any local air quality management planning efforts to attain and maintain standards

3.16.6.2 Potential Impacts Eliminated from Further Analysis

A determination has been made that long-term secondary air quality impacts associated with population growth (e.g., automobile exhaust, wood burning) would not occur as a consequence of the SFN System. Additionally, the lack of permanent sources of emissions associated with pipeline operation eliminates the consideration of long-term operational impacts.

3.16.6.3 Proposed Action

3.16.6.3.1 Impacts. The following sections describe construction-related impacts resulting from the Proposed Action.

3.16.6.3.1.1 Fugitive Dust/Particulate Matter Emissions. Construction of the Proposed Action would require activities that would produce air pollutant emissions. The most intensive construction activities producing emissions would occur during trenching and other excavation activities, when fugitive dust and vehicle exhaust emissions would be emitted. The approach used to assess air quality impacts was to define the impacts associated with a typical construction spread.

Fugitive dust would be emitted from several sources including construction of temporary access roads, clearing of the pipeline right-of-way, trenching, backfilling, travel over unpaved surfaces, and grading. In some areas, blasting that may be required would also cause the suspension of construction dust. The location of these emissions would change as segments of the pipeline are completed and construction moves to other locations. It is expected that no more than 600 feet of open trench would exist at any one time. Activities such as clearing of the pipeline right-of-way may occur a considerable distance in advance of the trench excavation and would

contribute to the overall impacts from construction dust. However, emissions from construction would not occur for any appreciable period of time at any one location.

Typical PM_{10} emissions associated with a construction spread were estimated, using emission factors from the Fourth Edition of AP-42, EPA's Compilation of Air Pollutant Emission Factors (EPA 1985). These emission estimates are contained in Table 3.16-4. Approximately 222 lb/day of construction dust PM_{10} emissions would be produced from a typical pipeline construction spread. Most of these emissions are from vehicle and equipment travel over unpaved roads or direct disturbance of the soil by excavation, grading, and compacting. Application of standard dust suppression techniques (e.g., soil stabilization or watering of trench stockpiles) would reduce daily PM_{10} emissions from 222 lb/day to 150 lb/day.

Table 3.16-4
Construction Dust PM_{10} Emissions from a Typical Construction Spread

Emission Source or Activity	Activity Factor	Emission Factor	Emission Rate (lb/day)
Wind erosion-temporary stockpiles	0.826 acre	6.3 lb/acre/day	5.21
Excavation	8 dozer-hours/day	3.16 lb/hour	25.28
Unpaved roads	44 miles	1.677 lb/mile	73.79
Compacting	10 hours/day	3.16 lb/hour	31.60
Grading	5 miles	11.48 lb/mile	57.40
Backfill (dozer)	8 dozer-hours/day	3.16 lb/hour	25.28
Wind erosion	2 acres	1.7 lb/acre/day	3.40
Total Fugitive Dust			**221.96**

Assumptions:
- Typical construction spread includes excavation sufficient for 600 feet of pipeline per day.
- Stockpile is 216,000 cubic feet of trench material stockpiled to a depth of 6 feet.
- Compacting and backfill emission factors are assumed to be similar to those for excavation.
- Silt content = 15 percent, 88 days per year of rain > 0.01 inch, winds > 12 mph for 1.33 percent of year.

Construction equipment exhaust would include emissions of CO, NO_x, SO_2, reactive organic gases, and PM_{10}. Summaries of the types of equipment used in a typical construction spread and the monthly equipment emissions are presented in Tables 1-19 and 1-20 in Chapter 1. Emission factors for equipment exhaust were based on an EPA study of non-road vehicle and engine emissions (EPA 1991). The total daily emissions from both equipment exhaust and construction dust are shown in Table 3.16-5.

3.16.6.3.1.2 Air Quality Impacts. The short-term impacts of emissions from a typical construction spread were assessed by applying the EPA's Fugitive Dust Model (FDM) to the emission estimates in Tables 3.16-4 and 3.16-5. The FDM produces estimates of ambient impacts of PM_{10} emissions, taking into account the settling and deposition of particles of various size categories (Winges 1992). The FDM model was run for a series of meteorological conditions (i.e., wind speeds and stability classes) assuming a worst case condition of wind blowing directly across the construction spread at a 90° angle. A typical summertime peak 24-hour background concentration of 75 micrograms per cubic meter ($\mu g/m^3$) was assumed. Both construction dust and equipment exhaust PM_{10} emissions were included.

Table 3.16-5 Summary of Total Daily Construction Emissions					
Emission Source Category	Daily Emissions (lb/day)				
	CO	Reactive Organic Gases	NO_x	SO_2	PM_{10}
Equipment Exhaust	101	24	225	21	19
Construction Dust	0	0	0	0	222
Total	**101**	**24**	**225**	**21**	**241**

Modeling assumes actions would be taken to minimize short-term construction dust and long-term wind erosion. These actions would be implemented as standard operating procedures or best management practices and would be specified in the individual construction contracts prepared by the CUWCD. Appendix B, *Standard Operating Procedures*, identifies the specific steps that would be taken to minimize activities leading to dust generation and to mitigate emissions that would occur. In addition, implementation of the SFN System *Erosion Control, Maintenance, and Revegetation Plan* (see Appendix A) would prevent long-term impacts from wind erosion of disturbed surfaces. This plan has specified that all disturbed soils would be seeded within 6 days of final grading. An effect of revegetation would be to stabilize disturbed soil in a manner that would minimize both soil and water erosion.

The results of the FDM model run for PM_{10} show that the federal 24-hour PM_{10} standard may be exceeded to a distance of 200 meters (approximately 670 feet) from construction activities. This occurrence of emissions in excess of the standard could be characterized as being temporary and localized in extent. Based on the significance criteria and results of the FDM model, estimated exceedences in the federal 24-hour PM_{10} standard are considered significant. Modeling of the gaseous equipment exhaust emissions with the FDM model was also conducted; the results are shown in Table 3.16-6.

Table 3.16-6 Gaseous Equipment Exhaust Emissions			
Pollutant	Averaging Time	Peak Impact ($\mu g/m^3$)	Ambient Standard ($\mu g/m^3$)
CO	1 hours 8 hours	244 122	40,000 10,000
SO_2	3 hours 24 hours	46 16	1,300 365

The above results indicate that gaseous exhaust emissions would produce a peak impact that is a very small fraction of the health-based standard and would not produce a significant impact. The magnitude of peak CO impacts would be 1 percent or less of the ambient standard and would be located many miles from the CO nonattainment area in Provo and Orem. Annual impact estimates cannot be made since the location of emissions would be constantly changing and thus, the location of the impact would also not be constant. Estimates were not made for NO_2, because no short-term ambient air quality standard exists.

3.16.6.3.1.3 Impacts on Efforts to Attain PM_{10} Standard. The emission of PM_{10} in and near Utah County may have an impact on efforts to meet the PM_{10} standard. As indicated earlier, Utah County is a nonattainment area and is implementing a plan to bring the area into attainment. It is very unlikely that SFN System construction emissions would have any significant effect on these efforts as PM_{10} levels would be reduced to near background levels at distances of less than 1 mile from construction sites. The North Provo monitoring station is located more than 15 miles from areas where construction would take place. The monitored PM_{10} violations in Utah County are located in areas that are considerably more populated than those near the SFN System. Therefore, the impact of construction emissions on areas in which the PM_{10} standard is currently exceeded would not be significant. This conclusion is strengthened by the fact that the PM_{10} standard is currently exceeded in Utah County during only two months: January and February. During these winter months, pipeline construction activities are expected to be minimal because of weather considerations.

3.16.6.3.1.4 On-Farm Agricultural Practices. With the development of the SFN System, it is expected that a change in agricultural practices would occur within the on-farm areas described in Section 1.9. Agricultural emissions would primarily result from land disturbance activities (e.g., plowing) and farm equipment exhaust. It is expected that conversions in crop types would not increase fugitive dust emissions (e.g., converting plowed farmland to unplowed orchards would likely lower fugitive dust emissions). Additionally, while some changes in farm equipment usage may occur, it is expected that this would not result in a net increase in vehicle emissions. Therefore, no significant air quality impacts would be expected to result from changes to on-farm practices.

3.16.6.3.2 Mitigation. None.

3.16.6.3.3 Unavoidable Adverse Impacts. Based on the analysis conducted, it appears that temporary, extremely localized violations of the federal 24-hour PM_{10} standard could occur. Any unavoidable significant impacts would occur only in locations immediately adjacent to the heaviest construction activity and would occur over a limited period of time.

3.16.6.4 MCAPW-DFT Alternative

Air quality impacts under the MCAPW-DFT Alternative would be similar to those identified for the Proposed Action, as similar equipment and construction techniques would be used during construction. The possible exceedence of PM_{10} standards would be less likely than under the Proposed Action, because of the reduced extent of related actions under this alternative.

3.16.6.4.1 Mitigation. None.

3.16.6.4.2 Unavoidable Adverse Impacts. The potential unavoidable adverse impacts would be the same as those described for the Proposed Action.

3.16.6.5 MCAP Alternative

Air quality impacts under the MCAP Alternative would be similar to those identified for the Proposed Action, as similar equipment and construction techniques would be used during construction.

3.16.6.5.1 Mitigation. None.

3.16.6.5.2 Unavoidable Adverse Impacts. The potential unavoidable adverse impacts would be the same as those described for the Proposed Action.

3.16.6.6 MCAPW Alternative

Air quality impacts under the MCAPW Alternative would be similar to those identified for the Proposed Action, as similar equipment and construction techniques would be used during construction. The possible exceedence of PM_{10} standards would be less likely than under the Proposed Action, because of the reduced extent of related actions under this alternative.

3.16.6.6.1 Mitigation. None.

3.16.6.6.2 Unavoidable Adverse Impacts. The potential unavoidable adverse impacts would be the same as those described for the Proposed Action.

3.16.6.7 MCATC Alternative

Air quality impacts under the MCATC Alternative would be similar to those identified for the Proposed Action, as similar equipment and construction techniques would be used during construction.

3.16.6.7.1 Mitigation. None.

3.16.6.7.2 Unavoidable Adverse Impacts. The potential unavoidable adverse impacts would be the same as those described for the Proposed Action.

3.16.6.8 MCAT Alternative

Air quality impacts under the MCAT Alternative would be similar to those identified for the Proposed Action, as similar equipment and construction techniques would be used during construction. The possible exceedence of PM_{10} standards would be less likely than under the Proposed Action, because of the reduced extent of related actions under this alternative.

3.16.6.8.1 Mitigation. None.

3.16.6.8.2 Unavoidable Adverse Impacts. The potential unavoidable adverse impacts would be the same as those described for the Proposed Action.

3.16.6.9 No Action Alternative

3.16.6.9.1 Impacts. Construction of Three Forks Dam would result in a localized increase in air emissions as a result of construction equipment and activities in the Diamond Fork drainage and from construction of locally developed M&I systems. An exceedence of PM_{10} standards would be less likely than under any other SFN System alternative, but would be possible.

3.16.6.9.2 Mitigation. None.

3.16.6.9.3 Unavoidable Adverse Impacts. Potential unavoidable adverse impacts could result from localized PM_{10} emissions during the construction of Three Forks Dam and Reservoir and M&I systems.

3.16.6.10 Summary of Impacts

A summary of impacts under the Proposed Action and each of the alternatives is presented in Table 3.16-7.

Table 3.16-7
Summary of Impacts for Air Quality Resources

Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action and All Alternatives				
PM_{10}	Temporary localized exceedence of PM_{10} standard during construction.	Significant	None	Significant

3.16.6.11 Cumulative Impacts

Section 1.8 identifies projects to be considered for cumulative impacts associated with both their development and the development of the SFN System. Because of the limited geographical aspects of air quality impacts associated with the SFN System, it has been determined that no significant cumulative impacts to air quality would result from construction and operation of the SFN System.

3.17 Mineral and Energy Resources

3.17.1 Introduction

This section provides a description of the mineral and energy resources that could be affected by the SFN System and related actions and addresses potential impacts to these resources.

3.17.2 Issues Eliminated from Further Analysis

The following potential impacts on mineral and energy resources have been eliminated from further analysis for the reasons listed below.

- The Proposed Action and alternatives would not affect energy resources of oil, gas, coal, and oil shale because these resources do not occur in marketable quantities near any of the proposed facilities described in Chapter 1 (UDNR, Geological and Mineral Survey 1983a).

- The Proposed Action and alternatives would not affect the operation of the Dream Mine because the mine is inactive and is located outside the impact area of influence.

- The Proposed Action and alternatives would not affect the hydroelectric powerhouse on Peteetneet Creek because flows in Peteetneet Creek at the powerhouse site would not change as a result of the SFN System.

3.17.3 Issues Addressed in the Impact Analysis

No issues or concerns on the subject of mineral or energy resources were raised by the public or by federal, State, or local agencies during the scoping process. However, the following issues related to mineral or energy resources are addressed in this section.

- Potential adverse impacts on the energy production of the two SVP hydroelectric power plants on the Spanish Fork River

- Potential adverse impacts on the development of nonmetallic mineral resources (including sand, gravel, gypsum, anhydride, and clays)

3.17.4 Description of Impact Area of Influence

The impact area of influence includes the mineral and energy resources that occur within 300 feet of proposed SFN System and related facilities.

3.17.5 Affected Environment

3.17.5.1 Energy Resources

Two hydroelectric power plants are located within the impact area of influence. These upper and lower SVP hydroelectric power plants are owned and operated by the SWUA. The upper power plant has a capacity of 3,500 kilowatts and the lower power plant has a capacity of 370 kilowatts.

The water that passes through the power plants is diverted from the Spanish Fork River at the Strawberry Diversion Dam. The water is conveyed to the power plants in the 3.3-mile-long Strawberry Power Canal, which

has a capacity of 500 cfs. The terminus of the power canal serves as a forebay for the upper Strawberry power plant and as the headworks for the High Line Canal. It is also the location where the flow of water is divided, with up to 240 cfs released into the High Line Canal to meet irrigation demands and the balance of water released to flow through a steel penstock to the upper Strawberry power plant. During the non-irrigation season, all of the flows in the Strawberry Power Canal are released through the upper power plant.

From the tailrace of the upper power plant, the flow is again divided. Part of the flow, up to 130 cfs, is released into a canal that serves the Salem and Spanish Fork South Irrigation Companies. The remainder of the water flows through the lower power plant and into the Spanish Fork River. During the non-irrigation season, all flows passing through the upper power plant also pass through the lower power plant.

3.17.5.2 Mineral Resources

This section describes the mineral (nonmetallic) resources that could be affected by development of the SFN System and related actions.

3.17.5.2.1 Sand and Gravel. Sources of both sand and gravel are located within the impact area of influence in eastern Juab County. These include an active gravel pit northeast of Santaquin and a borrow pit. (A borrow pit is an excavated area where sand and gravel are mined for use in another area.)

3.17.5.2.2 Gypsum and Anhydride. The Salt Creek Diversion Dam and Salt Creek Pipeline would be located within a potential gypsum and anhydride deposit east of Nephi. An active gypsum quarry is located approximately 0.5 mile east of Nephi, south of Salt Creek (UDNR, Geological and Mineral Survey 1983b).

3.17.5.2.3 Clays. Clay deposits are located near the city of Payson (UDNR, Geological and Mineral Survey 1983b). The Payson Pipeline would pass through an area of potential clay deposits between distance markers 70,000 and 80,000. The proposed Peteetneet Pipeline would pass through an area of potential clay deposits between distance markers 60,000 and 62,000, but there are no clay mining operations near the Peteetneet Pipeline.

3.17.6 Impact Analysis

3.17.6.1 Significance Criteria

Impacts to mineral and energy resources were considered significant if the construction, operation, or maintenance of the SFN System and related actions would prevent or disrupt the development of mineral or energy resources.

3.17.6.2 Potential Impacts Eliminated from Further Analysis

The following potential impacts were eliminated from further review:

- Based on the construction procedures described in Chapter 1 and the impact analysis contained in Section 3.15, Transportation, any construction activities involving crossings of local or minor roadways would involve the closing of one lane at a time and temporary delays up to 15 minutes. These closures and delays are not likely to have an impact on mining operations.

- Potential impacts to mineral and energy resources as a result of improvements to on-farm systems would not occur since improvements would be made to existing systems and no new lands would be put into agricultural production.

- No impacts to mineral and energy resources are anticipated from construction of the M&I distribution systems since they would be built within existing city limits as identified in Appendix C, *Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template.*

3.17.6.3 Proposed Action

The following sections describe the construction- and operation-related impacts that could result from the SFN System and related actions. These impacts are summarized in Section 3.17.6.11.

3.17.6.3.1 Energy Resources. Construction and operation of the Proposed Action would decrease energy production of the upper and lower Strawberry power plants, thereby disrupting the development of this energy resource. Construction of the Salem and South Field Distribution Systems would reduce flows through the upper Strawberry power plant because the new distribution system would receive water via the Strawberry Power Canal, thereby bypassing the upper powerhouse. As discussed in Chapter 1, CRSP replacement power would be used to offset any of this lost generation potential; therefore, there would be no net loss of energy resources within the impact area of influence and no significant impacts.

3.17.6.3.2 Mineral Resources

3.17.6.3.2.1 Sand and Gravel. Construction of the Santaquin, Mona, and Nephi pipeline segments of the Main Conveyance Aqueduct could potentially impact the development of existing sand and gravel sources by limiting the expansion of mining activities. The width of the permanent right-of-way for the Santaquin, Mona, and Nephi Pipelines would be 100 feet, within which mining activities would not be allowed. This could prevent the development of mineral resources and would be a significant impact.

3.17.6.3.2.2 Gypsum and Anhydride. Construction of the Salt Creek Diversion Dam and Salt Creek Pipeline could potentially restrict the development of gypsum and anhydride deposits east of Nephi by limiting the expansion of mining activities. This could prevent the development of these mineral resources, which would be a significant impact.

3.17.6.3.2.3 Clays. Construction of the Payson Pipeline could restrict the development of clay deposits between Turnouts SU4 and SU5 on the proposed Main Conveyance Aqueduct. This is considered a significant impact.

Lands where mineral resources (i.e., sand and gravel sources, gypsum and anhydride deposits, and clay deposits) would be crossed by the Santaquin, Mona, and Nephi Pipelines, Salt Creek Diversion Dam, Salt Creek Pipeline, and Payson Pipeline would be acquired in fee through negotiations with the landowners.

3.17.6.3.3 Mitigation. No mitigation measures would be required.

3.17.6.3.4 Unavoidable Adverse Impacts. The loss of access to sand and gravel sources, gypsum and anhydride deposits, and clay deposits that would prevent their development would result in an unavoidable adverse impact.

3.17.6.4 MCAPW-DFT Alternative

Impacts of and mitigation for the MCAPW Alternative would be the same as those described for the Proposed Action.

3.17.6.5 *MCAP Alternative*

Impacts of and mitigation for the MCAPW Alternative would be the same as those described for the Proposed Action.

3.17.6.6 *MCAPW Alternative*

Impacts of and mitigation for the MCAPW Alternative would be the same as those described for the Proposed Action.

3.17.6.7 *MCATC Alternative*

Impacts of and mitigation for the MCATC Alternative would be the same as those described for the Proposed Action although the location of affected clay deposits is different.

3.17.6.8 *MCAT Alternative*

Impacts of and mitigation for the MCAT Alternative would be the same as those described for the MCATC Alternative, except that construction and operation of the MCAT Alternative would decrease energy production of the upper and lower Strawberry power plants. The decrease in energy production would be less than that described for the Proposed Action because the Salem and South Field distribution pipelines would not be constructed.

3.17.6.9 *No Action Alternative*

Under the No Action Alternative, no SFN System or local development facilities would be constructed; therefore, there would be no effects on mineral and energy resources. Construction of Three Forks Dam and Reservoir would not result in any adverse impacts on mineral or energy resources.

3.17.6.10 *Summary of Impacts*

A summary of impacts for the Proposed Action and each of the alternatives is presented in Table 3.17-1.

3.17.7 Cumulative Impacts

Section 1.8 identifies projects to be considered in the cumulative impact analysis. These projects would not affect the same mineral and energy resources that occur within the impact area of influence of the Proposed Action and other alternatives. Therefore, there would be no cumulative mineral and energy impacts.

Table 3.17-1
Summary of Impacts to Mineral and Energy Resources

Resources	Impact	Significance	Mitigation	Significance After Mitigation
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, and MCAT Alternatives				
Sand and Gravel	Potential impact to development of existing sand and gravel sources by limiting expansion of mining activities.	Significant	None	Significant
Gypsum and Anhydride	Potential impact to development of gypsum and anhydride deposits by limiting expansion of mining activities.	Significant	None	Significant
Clays	Potential impact to development of clay deposits by preventing development of deposits.	Significant	None	Significant
No Action Alternative				
No impacts				

3.18 Land Use

3.18.1 Introduction

This section discusses inconsistencies between the existing land use plans within the SFN System area and land use requirements of the SFN System. A number of local, State, and federal agencies have jurisdiction over certain lands on which the SFN System and related facilities would be located. A comprehensive analysis was conducted to identify the construction and operational aspects of the SFN System and related facilities that would be in conflict with existing land use plans and designations.

3.18.2 Issues Eliminated from Further Analysis

No land use issues were identified during the formal scoping process; therefore, no issues were eliminated from further analysis.

3.18.3 Issues Addressed in the Impact Analysis

The construction and operation of the Proposed Action and alternatives would encroach upon portions of USFS-designated "roadless areas" within the Uinta National Forest. In some instances, this encroachment would be in conflict with the Uinta National Forest Land and Resource Management Plan (USFS, Undated a). However, the existing management plan currently recognizes that the CUP may require some development within designated roadless areas.

3.18.4 Description of Impact Area of Influence

The impact area of influence consists of managed land areas within southern Utah and eastern Juab Counties in which the Proposed Action and alternatives and related facilities would be located.

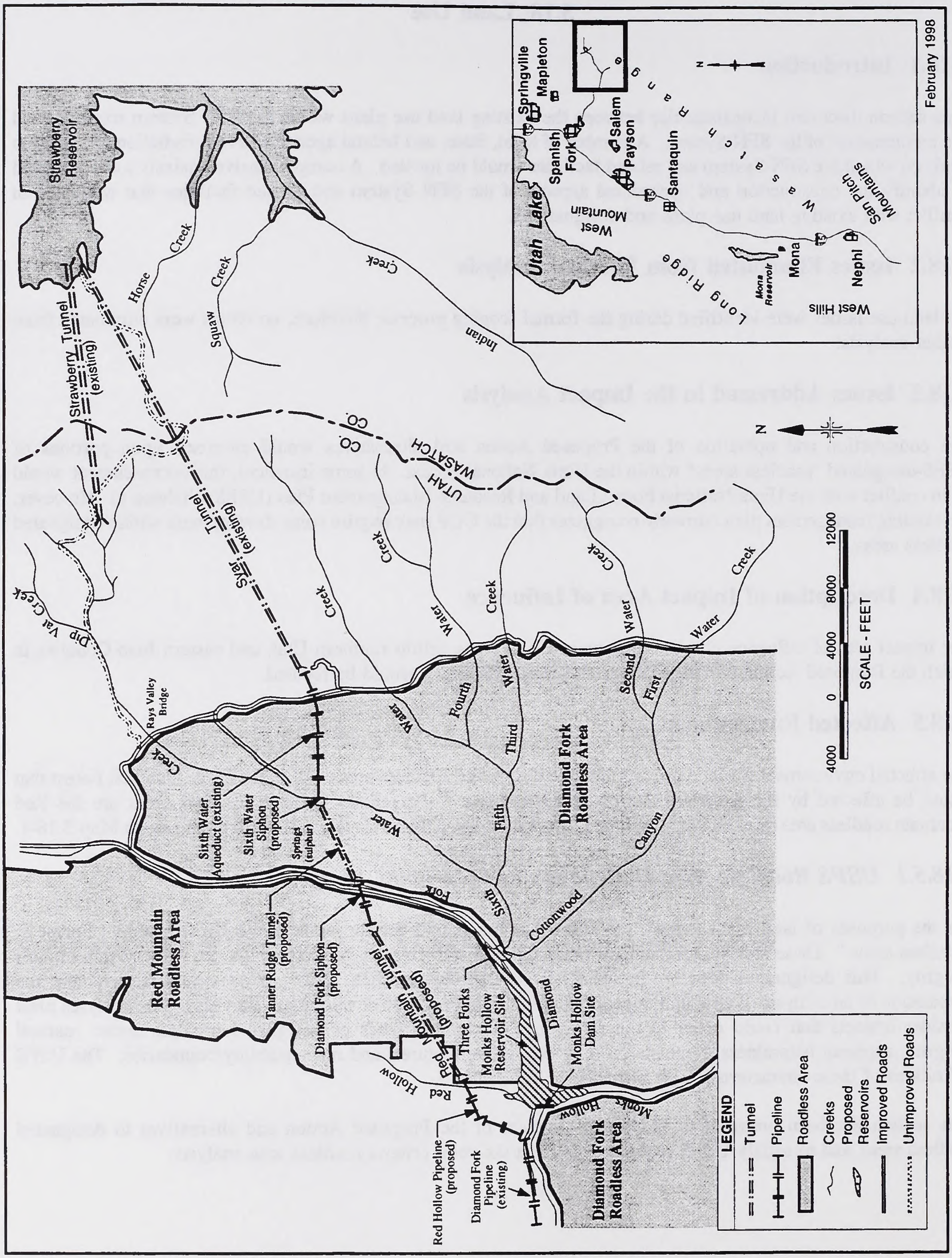
3.18.5 Affected Environment

The affected environment for land use is limited to designated roadless areas within the Uinta National Forest that would be affected by the Proposed Action and alternatives. Potentially affected roadless areas are the Red Mountain roadless area (area #18714) and the Diamond Fork roadless area (area #18716) as shown on Map 3.18-1.

3.18.5.1 USFS Roadless Area Designation and Six-Point Analysis Criteria

For the purposes of land management, the USFS has designated certain lands in the Uinta National Forest as "roadless areas." These areas exhibit unique characteristics and are managed to promote the preservation of their integrity. This designation does not preclude all development in such areas. It does, however, require the preparation of an analysis of potential impacts resulting from proposed development activities. The analyses must consider impacts that could occur to the following six characteristics of designated roadless areas: natural integrity, apparent naturalness, remoteness, solitude, special features, and manageability/boundaries. The USFS definitions of these characteristics are provided in Table 3.18-1.

This section has been prepared to address the impacts of the Proposed Action and alternatives to designated roadless areas and to satisfy USFS requirements for a six-point criteria roadless area analysis.



Map 3.18-1
Diamond Fork and Red Mountain Roadless Areas

Table 3.18-1
Definitions of USFS Six Roadless Area Characteristics

Characteristic	Definition
Natural Integrity	Natural integrity is the extent to which long-term ecological processes are intact and operating. Impacts to natural integrity are measured by the presence and magnitude of human-induced change to an area. Such impacts include physical developments (e.g., roads, utility rights-of-way, fences, lookouts, cabins), recreational developments, domestic livestock grazing, mineral developments, wildlife/fisheries management activities, vegetative manipulation, and fire suppression activities.
Apparent Naturalness	The environment looks natural to most people using the area. It is a measure of the importance of visitors' perceptions of human impacts to the area. Even though some of the long-term ecological processes of an area may have been interrupted, the landscape of the area generally appears to be affected by the forces of nature. If the landscape has been modified by human activity, the evidence is not obvious to the casual observer or it is disappearing as the result of natural processes.
Remoteness	A perceived condition of being secluded, inaccessible, and out-of-the-way. The physical factors that can create "remote" settings include topography, vegetative screening, distance from human impacts such as roads and logging operations (sight and sound), and difficulty of travel. A user's sense of remoteness in an area is also influenced by the presence or absence of roads, their condition, and whether they are open to motorized vehicles.
Solitude	A personal, subjective value defined as isolation from the sights, sound, and presence of others and the developments of man. Common indicators of solitude are numbers of individuals or parties one may expect to encounter in an area during a day or the number of parties camped within sight and sound of other visitors. A primitive recreation experience includes the opportunity to experience solitude, a sense of remoteness, closeness to nature, serenity, and spirit of adventure through the application of woodsmen skills in an environment that offers a high degree of challenge and risk.
Special Features	Those unique geological, biological, ecological, cultural, or scenic features that may be located in roadless areas. Unique fish and wildlife species, unique plants or plant communities, potential Research Natural Areas, outstanding landscape features such as unique rock formations, and significant cultural resource sites are some of the items that should be considered when analyzing this element.
Manageability/ Boundaries	This element relates to the ability of the USFS to manage an area to meet size criteria and the five other roadless area characteristics. Changes in the shape of an area influence how it can be managed.

Source: USFS, *Definitions of Roadless Area Characteristics* (Tidwell 1997)

3.18.5.2 Description of Potentially Affected Roadless Areas

Two roadless areas would be affected to varying degrees by the Proposed Action and each of the alternatives with the exception of the No Action Alternative; these are the Diamond Fork and Red Mountain roadless areas. The No Action Alternative would affect the Diamond Fork roadless area, but would not affect the Red Mountain roadless area. These effects are discussed in Section 3.18.6.

3.18.5.2.1 Diamond Fork Roadless Area. The Diamond Fork roadless area is located on the east side of Diamond Fork Road. The area is 32,880 acres in size and is located within the Uinta National Forest. The area

is utilized for cattle grazing, and some range improvements, including water troughs and fences, are located within the area boundaries. Additionally, some portions of the area have undergone range revegetation.

The natural integrity of this area is low. It is surrounded by roadways, and roads and all-terrain vehicle tracks penetrate deeply into some areas. Recreational opportunities within the area include hunting and, to a limited extent, primitive recreation in some of the deeper valleys.

Management activities within the roadless area include planning for the development of Monks Hollow Dam and Reservoir as an aspect of the CUP. However, as a result of the Proposed Action, as discussed in this document, both negative and beneficial impacts may not occur as anticipated in the Uinta Land and Resource Management Plan.

3.18.5.2.2 Red Mountain Roadless Area. The Red Mountain roadless area is located north of Monks Hollow, on the west side of Diamond Fork Road. The area is 9,120 acres in size and is located entirely within the Uinta National Forest. Bordering this area on the south and east are two small developed recreation sites. Cattle grazing occurs throughout the area and range improvements, including water troughs and fences, are located within the area boundaries.

The area has a natural appearance and a high degree of natural integrity. The area does not offer significant opportunities for solitude as it is virtually surrounded and, in some cases, penetrated by roads. Recreational opportunities exist within the area, including dispersed camping, hunting, hiking, and trail bike and horseback riding. The area is also used extensively for snowmobiling.

Management activities within the area include planning for the development of Monks Hollow Reservoir as an aspect of the CUP. The USFS expects that approximately 640 acres, or 12 percent of the land area, would be impacted by Diamond Fork System development. However, as a result of the Proposed Action, both negative and beneficial impacts may not occur as anticipated in the Uinta Land and Resource Management Plan.

3.18.6 Impact Analysis

This section discusses the land use impacts associated with the construction and operation of the Proposed Action and alternatives. For reasons discussed in Sections 3.18.4 and 3.18.5, this impact analysis is limited to the Diamond Fork and Red Mountain roadless areas within the Uinta National Forest and provides a six-point roadless area analysis to address potential impacts.

3.18.6.1 Proposed Action

The Proposed Action would require construction activities and the installation of permanent pipeline-related facilities within the Red Mountain and Diamond Fork roadless areas. Construction-related activities occurring within the roadless areas would include building access roads and laydown areas, tunnel drilling operations, and pipeline installation activities such as trenching, pipe laying, and recontouring (see Chapter 1, Sections 1.6.2.9 and 1.6.2.10 for a detailed description of construction activities). Permanent surface facilities that would remain within these roadless areas include access roads, tunnel portals, and vent and access hatch structures along the "Diamond Fork Tunnel Alternative" right-of-way.

3.18.6.1.1 Diamond Fork Roadless Area. This section identifies the features of the Proposed Action within the Diamond Fork roadless area and describes the resulting impacts.

3.18.6.1.1.1 Tanner Ridge Tunnel Inlet Portal Access Road. Approximately 1.7 miles of existing USFS Road #622 within the Diamond Fork roadless area would be extended approximately 0.3 mile and used to provide access to the Tanner Ridge Tunnel inlet portal. High levels of use would occur during construction of the tunnel.

Following completion of the tunnel, traffic on the access road would be limited to maintenance activities. A locked gate currently exists on this access road outside of the roadless area boundary to limit public vehicle access into the roadless area. The gate would remain in place and restricted access would continue following the completion of construction.

3.18.6.1.1.2 Tanner Ridge Tunnel Inlet Portal. Construction activities at the Tanner Ridge Tunnel inlet portal would require the clearing of less than 1 acre of land.

3.18.6.1.1.3 Tanner Ridge Tunnel Outlet Portal. Construction activities at the Tanner Ridge Tunnel outlet portal would require clearing 2 acres of land for construction-related activities and an additional 2 acres for tunnel waste material disposal.

3.18.6.1.1.4 Tanner Ridge Tunnel Outlet Portal Access Road. Approximately 0.9 mile of new road would be constructed within the Diamond Fork roadless area to provide access to the Tanner Ridge Tunnel outlet portal. High levels of use would occur during construction of the tunnel. Following completion of the tunnel, traffic on the access road would be limited to maintenance activities. A locked gate would be installed on the road outside the roadless area boundary to restrict vehicular access by the public into the roadless area.

3.18.6.1.1.5 Diamond Fork Siphon. Approximately 0.4 mile of the eastern end of the Diamond Fork Siphon would be located within the Diamond Fork roadless area. Construction of the siphon within this roadless area would require clearing approximately 1 acre of land. Following construction activities, disturbed land would be restored to near its original condition. Pipeline vent and access hatch structures would be located at varying intervals along the pipeline alignment and would be visible to area users.

3.18.6.1.2 Red Mountain Roadless Area. This section addresses the features of the Proposed Action that would impact the Red Mountain roadless area.

3.18.6.1.2.1 Diamond Fork Siphon. Approximately 0.5 mile of the western end of the Diamond Fork Siphon would be located within the Red Mountain roadless area. Construction of the siphon within this roadless area would require clearing approximately 1 acre of land. Following construction activities, disturbed land would be restored to near its original condition. Pipeline vent and access hatch structures would be located at varying intervals along the siphon alignment and would be visible to area users.

3.18.6.1.2.2 Red Mountain Tunnel Inlet Portal Access Road. Approximately 0.6 mile of new road would be constructed within the Red Mountain roadless area to provide access to the Red Mountain tunnel outlet portal. High levels of use would occur during construction of the tunnel. Following completion of the tunnel, traffic on the access road would be limited to maintenance activities. A locked gate would be installed on the road outside the roadless area boundary to restrict vehicular access by the public into the roadless area.

3.18.6.1.2.3 Red Mountain Tunnel Inlet Portal. Construction activities at the Red Mountain Tunnel inlet portal would require the clearing of approximately 2 acres of land.

3.18.6.1.2.4 Red Mountain Tunnel Outlet Portal. Construction activities at the Red Mountain Tunnel outlet portal would require clearing approximately 2 acres of land for construction-related activities and 3 acres for tunnel waste material disposal.

3.18.6.1.2.5 Red Mountain Tunnel Outlet Portal Access Road. Approximately 0.5 mile of new road would be constructed within the Red Mountain roadless area to provide access to the Red Mountain Tunnel outlet portal. High levels of use would occur during construction of the tunnel. Following completion of the tunnel, traffic on the access road would be limited to maintenance activities. A locked gate would be installed on the road outside the roadless area boundary to restrict vehicular access by the public into the roadless area.

3.18.6.1.2.6 ***Red Hollow Pipeline.*** Approximately 0.25 mile of the eastern end of the 2.5-mile-long Red Hollow Pipeline would be located within the Red Mountain roadless area. Construction of the pipeline within this roadless area would require clearing approximately 0.5 acre of land. Following construction activities, disturbed land would be restored to near its original condition. Pipeline vent and access hatch structures would be located at varying intervals along the pipeline alignment and would be visible to area users.

3.18.6.1.3 Six-Point Criteria Roadless Area Analysis. An analysis of the impacts resulting from SFN System features that would be constructed within the Diamond Fork and Red Mountain roadless areas under the Proposed Action is provided in Table 3.18-2.

3.18.6.2 MCAPW-DFT Alternative

Impacts to the Diamond Fork and Red Mountain roadless areas under the MCAPW-DFT Alternative would be the same as those described for the Proposed Action.

Table 3.18-2
Proposed Action and MCAPW-DFT Alternative Six-Point Roadless Area Analysis

Page 1 of 2

Roadless Area Characteristic	Effect on Characteristic
Diamond Fork Roadless Area	
Natural Integrity	The Proposed Action would have a slight impact on the natural integrity of the Diamond Fork roadless area. The area is already penetrated by roads in some areas and the additional roads that would be constructed would be located near the perimeter. Visible project-related features at the tunnel portals would be limited and would not significantly detract from the existing integrity of the natural features in the area.
Apparent Naturalness	The Proposed Action would have a slight impact on the natural appearance of the Diamond Fork roadless area. Because of existing man-made structures and facilities, the limited scope of the SFN System within the area boundaries would not significantly affect the existing naturalness of the area.
Remoteness	The Proposed Action would not have a long-term impact on the remoteness of the Diamond Fork roadless area. Access roads would be locked and rarely used following construction. The area is already surrounded by roads and existing "remoteness" is limited.
Solitude	The Proposed Action would impact opportunities for solitude within the Diamond Fork roadless area during construction. Construction-related traffic and activities would reduce the solitude characteristics in the immediate construction areas. However, because of the limited scope of the SFN System within the area boundaries, the impact would be relatively small. There would be no long-term impact to the solitude characteristics of the area.
Special Features	The Proposed Action would not affect any special features of the Diamond Fork roadless area.
Manageability and Boundaries	The Proposed Action would not affect the manageability or boundaries of the Diamond Fork roadless area. The SFN System would not affect USFS access to the area, nor would it require a change in the Diamond Fork roadless area boundaries.

Table 3.18-2
Proposed Action and MCAPW-DFT Alternative Six-Point Roadless Area Analysis
Page 2 of 2

Roadless Area Characteristic	Effect on Characteristic
Red Mountain Roadless Area	
Natural Integrity	The Proposed Action would have a slight impact on the natural integrity of the Red Mountain roadless area. The area is already penetrated by roads in some areas and the additional roads that would be constructed would be located near the perimeter. Visible project-related features at the tunnel portals would be limited and would not significantly detract from the existing integrity of the natural features in the area.
Apparent Naturalness	The Proposed Action would have a slight impact on the natural appearance of the Red Mountain roadless area. Because of existing man-made structures and facilities, the limited scope of the SFN System within the area boundaries would not significantly affect the existing naturalness of the area.
Remoteness	The Proposed Action would not have a long-term impact on the remoteness of the Red Mountain roadless area. Access roads would be locked and rarely used following construction. The area is already surrounded by roads and existing "remoteness" is limited.
Solitude	The Proposed Action would impact opportunities for solitude within the Red Mountain roadless area during construction. Construction-related traffic and activities would reduce the solitude characteristics in the immediate construction areas. However, because of the limited scope of the SFN System within the area boundaries, the impact would be relatively small. There would be no long-term impact to the solitude characteristics of the area.
Special Features	The Proposed Action would not affect any special features of the Red Mountain roadless area.
Manageability and Boundaries	The Proposed Action would not affect the manageability or boundaries of the Red Mountain roadless area. The SFN System would not affect USFS access to the area, nor would it change the Red Mountain roadless area boundaries.

3.18.6.3 MCAP Alternative

Under the MCAP Alternative, the "Diamond Fork Tunnel Alternative" would not be built; however, Monks Hollow Dam would be constructed along Diamond Fork Creek at Monks Hollow. The dam, the resulting Monks Hollow Reservoir, and related access roads would be partially constructed within Uinta National Forest roadless areas. The land use impacts of these facilities were addressed in the *Diamond Fork Final EIS* (USBR 1984) and the *Final Supplement to FEIS, Diamond Fork System* (USBR 1990); however, a six-point roadless area analysis was not prepared. This section addresses potential impacts to Uinta National Forest roadless areas resulting from the MCAP Alternative and is intended to meet USFS six-point criteria roadless area analysis requirements.

3.18.6.3.1 Diamond Fork Roadless Area. Facilities developed within the Diamond Fork roadless area would be limited to portions of Monks Hollow Reservoir. The reservoir would encroach upon the roadless area, east of Monks Hollow at Diamond Fork Creek. While the reservoir would not have a direct impact on the roadless area beyond limited lost dry land area, it would result in the inundation of facilities located outside the roadless area, but utilized by area users. These facilities include a portion of Diamond Fork Road north of Monks Hollow, a trail within Monks Hollow, and a corral near Diamond Fork Creek upstream of Monks Hollow.

3.18.6.3.2 Red Mountain Roadless Area. Facilities developed within the Red Mountain roadless area would be limited to portions of Monks Hollow Reservoir. The reservoir would encroach upon the roadless area north of Monks Hollow at Diamond Fork Creek. Impacts to the Red Mountain roadless area would be the same as those described for the Diamond Fork roadless area.

3.18.6.3.3 Six-Point Criteria Roadless Area Analysis. A six-point criteria analysis of the impacts resulting from the development of Monks Hollow Reservoir within the Diamond Fork and Red Mountain roadless areas under the MCAP Alternative is provided in Table 3.18-3.

3.18.6.4 MCAPW Alternative

Impacts to both the Diamond Fork and Red Mountain roadless areas under the MCAPW Alternative would be the same as those described for the MCAP Alternative.

3.18.6.5 MCATC Alternative

Impacts to both the Diamond Fork and Red Mountain roadless areas under the MCATC Alternative would be the same as those described for the MCAP Alternative.

Table 3.18-3
MCAP, MCAPW, MCATC, and MCAT Alternatives Six-Point Roadless Area Analysis
Page 1 of 2

Roadless Area Characteristic	Effect on Characteristic
Diamond Fork Roadless Area	
Natural Integrity	The development of Monks Hollow Reservoir would have a slight adverse impact on the natural integrity of the Diamond Fork roadless area, as the reservoir would be a man-made feature. However, since the reservoir would impact only a small portion of the area and because of the natural appearance of the lake, this impact would be insignificant.
Apparent Naturalness	The development of Monks Hollow Reservoir would not affect the apparent naturalness of the Diamond Fork roadless area. The portions of the reservoir within the roadless area would appear similar to a natural lake.
Remoteness	The development of Monks Hollow Reservoir would have a beneficial impact on the remoteness characteristics of the Diamond Fork roadless area. The reservoir would eliminate opportunities for access to the area and, as such, would increase the remoteness of the area.
Solitude	The development of Monks Hollow Reservoir would not significantly change the solitude characteristics of the Diamond Fork roadless area. Development of the reservoir would result in introducing lake shoreline to the area. This could either add or detract slightly from the solitude characteristics, depending a great deal on the perceptions of area users.
Special Features	The development of Monks Hollow Reservoir would not affect any special features within the Diamond Fork roadless area.
Manageability and Boundaries	The development of Monks Hollow Reservoir would impact the manageability of portions of the Diamond Fork roadless area. The inundation of Diamond Fork Road and the Monks Hollow trail would eliminate certain access routes into the roadless area for both USFS personnel and the public and would affect the manageability of this roadless area. The reservoir would not have a significant impact on the boundaries of the roadless area.

Table 3.18-3
MCAP, MCAPW, MCATC, and MCAT Alternatives Six-Point Roadless Area Analysis
Page 2 of 2

Roadless Area Characteristic	Effect on Characteristic
Red Mountain Roadless Area	
Natural Integrity	The development of Monks Hollow Reservoir would have a slight adverse impact on the natural integrity of the Red Mountain roadless area, as the reservoir would be a man-made feature. However, since the reservoir would impact only a small portion of the area and because of the natural appearance of the lake, this impact would be insignificant.
Apparent Naturalness	The development of Monks Hollow Reservoir would not affect the apparent naturalness of the Red Mountain roadless area. The portions of the reservoir within the roadless area would appear similar to a natural lake.
Remoteness	The development of Monks Hollow Reservoir would have a beneficial impact on the remoteness characteristics of the Red Mountain roadless area. The reservoir would eliminate opportunities for access to the area and, as such, would increase the remoteness of the area.
Solitude	The development of Monks Hollow Reservoir would not significantly change the solitude characteristics of the Red Mountain roadless area. Development of the reservoir would result in introducing lake shoreline to the area. This could either add or detract slightly from the solitude characteristics, depending a great deal on the perceptions of area users.
Special Features	The development of Monks Hollow Reservoir would not affect any special features within the Red Mountain roadless area.
Manageability and Boundaries	The development of Monks Hollow Reservoir would impact the manageability of portions of the Red Mountain roadless area. The inundation of Diamond Fork Road would eliminate certain access routes into the roadless area for both USFS personnel and the public and would affect the manageability of this roadless area. The reservoir would not have a significant impact on the boundaries of the roadless area.

3.18.6.6 MCAT Alternative

Impacts to both the Diamond Fork and Red Mountain roadless areas under the MCAT Alternative would be the same as those described for the MCAP Alternative.

3.18.6.7 No Action Alternative

Under the No Action Alternative, no SFN System facilities would be constructed. However, certain facilities would be constructed in order to complete the Diamond Fork System. Facilities that would be constructed under the No Action Alternative within Uinta National Forest roadless areas include Three Forks Dam and Reservoir, which would be located on Sixth Water Creek just above its confluence with Diamond Fork Creek. The dam would be located near the western boundary of the Diamond Fork roadless area, and the reservoir would be located partially within the Diamond Fork roadless area. No other roadless areas would be affected by the No Action Alternative. Development of Three Forks Dam and Reservoir would inundate two trails leading into the Diamond Fork roadless area at Three Forks.

3.18.6.7.1 Six-Point Criteria Roadless Area Analysis. The effects that the construction of Three Forks Dam and Reservoir as a result of the No Action Alternative would have on the six roadless area characteristics of the Diamond Fork roadless area are documented in Table 3.18-4. This alternative would not affect the Red Mountain roadless area.

Table 3.18-4
No Action Alternative Six-Point Roadless Area Analysis

Roadless Area Characteristic	Effect on Characteristic
Diamond Fork Roadless Area	
Natural Integrity	The development of Three Forks Dam and Reservoir would have a slight negative impact on the natural integrity of the Diamond Fork roadless area, as the reservoir would be a man-made feature. However, since the reservoir would impact only a small portion of the area and because of the natural appearance of the lake, this impact would not be significant.
Apparent Naturalness	The development of Three Forks Dam and Reservoir would not affect the apparent naturalness of the Diamond Fork roadless area. The portions of the reservoir within the roadless area would appear similar to a natural lake.
Remoteness	The development of Three Forks Dam and Reservoir would have a beneficial impact on the remoteness characteristics of the Diamond Fork roadless area. The reservoir would eliminate certain points of access to the area and, as such, would increase the remoteness of the area.
Solitude	The development of Three Forks Dam and Reservoir would not significantly change the solitude characteristics of the Diamond Fork roadless area. Development of the reservoir would result in introducing lake shoreline to the area. This could either add or detract slightly from the solitude characteristics, depending a great deal on the perceptions of area users.
Special Features	The development of Three Forks Dam and Reservoir would not affect any special features within the Diamond Fork roadless area.
Manageability and Boundaries	The development of Three Forks Dam and Reservoir would impact the manageability of portions of the Diamond Fork roadless area. The inundation of Diamond Fork Road and the Monks Hollow trail would eliminate minor access routes into the roadless area for both USFS personnel and the public, but this would not affect the manageability of the area. The reservoir would not have a significant impact on the boundaries of the roadless area.

3.18.6.8 Summary of Impacts

The land use impacts resulting from the Proposed Action and alternatives are summarized in Table 3.18-5. The long-term effects to the six USFS-specified roadless area characteristics are summarized in Table 3.18-6. The degree (e.g., minor or moderate) of the effects on roadless area characteristics that would result from the Proposed Action and each of the alternatives, as identified in Tables 3.18-2, 3.18-3, and 3.18-4 are summarized in Table 3.18-6. The effects listed are adverse unless specified otherwise.

3.18.7 Cumulative Impacts

Land use impacts of the SFN System are limited to the Diamond Fork and Red Mountain roadless areas. Projects identified in Section 1.8 do not have any identifiable impacts on the Diamond Fork or Red Mountain roadless areas. Therefore, it is anticipated that there would be no cumulative impacts to these areas.

Table 3.18-5 Summary of Land Use Impacts				
Resource	**Impact**	**Significance**	**Mitigation**	**Significance After Mitigation**
Proposed Action and MCAPW-DFT, MCAP, MCAPW, MCATC, and MCAT Alternatives				
Diamond Fork Roadless Area	Certain features would be located and construction activities would take place within the Diamond Fork roadless area.	Not significant	None	Not significant
Red Mountain Roadless Area	Certain features would be located and construction activities would take place within the Red Mountain roadless area.	Not significant	None	Not significant
No Action Alternative				
Diamond Fork Roadless Area	Certain features would be located and construction activities would take place within the Diamond Fork roadless area.	Not significant	None	Not significant

Table 3.18-6
Summary of Six-Point Criteria Roadless Area Analysis (Long-Term Effects)

Roadless Area Characteristics	Proposed Action	MCAPW-DFT Alternative	MCAP Alternative	MCAPW Alternative	MCATC Alternative	MCAT Alternative	No Action Alternative
Diamond Fork Roadless Area							
Natural Integrity	Minor modification	Minor modification	Minor modification	Minor modification	Minor modification	Minor modification	Minor modification
Apparent Naturalness	Minor modification	Minor modification	None	None	None	None	None
Remoteness	No change	No change	Minor (beneficial modification)	Minor (beneficial) modification	Minor (beneficial) modification	Minor (beneficial) modification	Minor (beneficial) modification
Solitude	No change	No change	Minor (possibly beneficial modification)	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification
Special Features	No change	No change	No change	No change	No change	No change	No change
Manageability/ Boundaries	Minor modification	Minor modification	Moderate modification	Moderate modification	Moderate modification	Moderate modification	Minor modification
Red Mountain Roadless Area							
Natural Integrity	Minor modification	Minor modification	Minor modification	Minor modification	Minor modification	Minor modification	NA
Apparent Naturalness	Minor modification	Minor modification	None	None	None	None	NA
Remoteness	No change	No change	Minor (beneficial) modification	Minor (beneficial) modification	Minor (beneficial) modification	Minor (beneficial) modification	NA
Solitude	No change	No change	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification	Minor (possibly beneficial) modification	NA
Special Features	No change	No change	No change	No change	No change	No change	NA
Manageability/ Boundaries	Minor modification	Minor modification	Moderate modification	Moderate modification	Moderate modification	Moderate modification	NA

3.19 Indian Trust Assets and Environmental Justice

3.19.1 Indian Trust Assets

Under all alternatives, water from the Ute Indian Tribe of the Uintah and Ouray Indian Reservation would be diverted from the Uinta Basin as a result of the Indian Deferral Agreement signed in 1965 by the Ute Tribe, USBR, Bureau of Indian Affairs, and CUWCD. The deferral of water use was mutually considered until the year 2005, at which time, if suitable projects were not developed, an equitable adjustment would be made in accordance with Tribal water rights to permit the immediate Indian use of the water so reserved.

However, in 1992, CUPCA recognized unresolved Tribal claims arising out of the Deferral Agreement and legislated equitable adjustments for the Tribe with the intention to 1) quantify the Tribe's reserved water rights, 2) allow increased beneficial use of such water, and 3) put the Tribe in the same economic position it would have enjoyed had the features contemplated by the Deferral Agreement been constructed.

No other trust assets from any federally recognized tribe are known to be affected by the SFN System.

3.19.2 Environmental Justice

On February 11, 1994, the President of the United States issued Executive Order 12898 on Environmental Justice in Minority Populations and Low Income Populations (DOI 1994). The policy required the analysis and evaluation of impacts of any proposed project, action, or decision on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risks of those decisions.

Socioeconomic data analyzed for Utah and Juab Counties indicate that peoples of Hispanic origin and other minority races constitute 5.5 and 3.0 percent of Utah and Juab Counties, respectively. Data indicating the number of minority representatives located specifically in southern Utah and eastern Juab Counties are not available. Regarding low-income populations (i.e., families whose annual income is less than $9,999), 9.4 percent of families in Utah County and 6.3 percent of families in Juab County fall into this group (BEBR 1993). During the scoping and planning process described in Chapter 4 of this DEIS, no issues were identified that would impact only low-income or minority groups. The benefits derived from the SFN System would accrue to the entire population in the SFN System impact area of influence. SFN System facilities would not be concentrated in one area but would be located in a variety of locations that support low, middle, and higher income groups. No disproportionate negative impact to Hispanic or low-income communities is expected. Benefits to the agricultural industries that would occur as a result of the SFN System are expected to improve financial resources for all groups of people within the impact area of influence.

Chapter 4

CONSULTATION AND COORDINATION

Chapter 4
Consultation and Coordination

4.1 Introduction

This chapter documents the consultation and coordination activities (including public involvement) that were undertaken during the development of the Spanish Fork Canyon-Nephi Irrigation System (SFN System) Proposed Action and alternatives and this SFN System Draft Environmental Impact Statement (DEIS). Section 4.2 provides background information on the public involvement requirements for the SFN System. Section 4.3 describes the SFN System public involvement program, and Section 4.4 describes the scoping process. Section 4.5 discusses the consultation and coordination process implemented to encourage and solicit agency review and participation in the SFN System planning process. Section 4.6 concludes with information regarding the public hearings that will be held on this DEIS.

4.2 Background

4.2.1 Central Utah Project Completion Act Mandate for Public Involvement

The Central Utah Project Completion Act (CUPCA) mandates that any project covered under CUPCA cannot be planned or built without input from a broad range of groups interested in the future of Utah's water and environment. It requires that public involvement be pervasive in all aspects of a project, including planning each phase of construction and post-construction maintenance.

4.2.2 NEPA Requirements for Public Involvement

The National Environmental Policy Act (NEPA) requires that an Environmental Impact Statement (EIS) be prepared for all major federal actions significantly affecting the quality of the human environment. The Department of the Interior (DOI), the Central Utah Water Conservancy District (CUWCD), and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) are the joint lead agencies preparing an EIS for the SFN System to comply with the provisions of NEPA. A Notice of Intent (NOI) to prepare an EIS was published in the *Federal Register* on December 31, 1992 (CUWCD 1992a).

One of the steps in the EIS preparation process is "scoping," a public process designed to determine the scope of issues and alternatives to be analyzed in an EIS. Scoping occurs as early as possible after a lead agency decides to prepare an EIS, and the process is governed by the Council on Environmental Quality's (CEQ) regulations. The scoping process provides the general public, state and local governments, and affected federal agencies the opportunity to identify early in the planning process key issues and concerns that they believe should be studied in the EIS. Scoping also provides a mechanism to identify issues and potential impacts of minor concern and to limit the discussion of these impacts and issues in the EIS. An NOI to conduct public scoping meetings for the SFN System was published in the August 30, 1993 issue of the *Federal Register* (CUWCD 1993). The scoping process conducted for the SFN System is discussed in Section 4.4.

4.3 SFN System Public Involvement Program

A public involvement program for the SFN System was initiated in 1992 with the preparation of the *Early Consultation Public Involvement Plan for the Irrigation and Drainage System* (CUWCD 1992b). The program, which was developed in accordance with CUPCA requirements and mandates and CUWCD policies, provided a

forum in which concerned agencies, local water users, special interest groups, and other concerned individuals could participate in the SFN System planning process and affect decisions about specific issues. One of the key objectives of the program was to receive comments from the public on the criteria for selection of acceptable alternatives. The program also helped build consensus on the Proposed Action.

In early 1992, an advisory group called the SFN System Planning Team was formed to provide input on the planning process. Three geographic-specific planning teams were formed in the latter half of 1992. These Area Planning Teams included representatives of water use organizations, environmental groups having an interest in the SFN System, and representatives of local, State, and federal agencies. During this early consultation period for the SFN System, numerous Area Planning Team meetings were conducted to seek input on issues and activities that should be addressed as part of the planning and design of the SFN System. This included seeking recommendations on the design and focus of public involvement activities to better coordinate affected water users' input to the planning process. These public involvement activities are contained in eight informal volumes (no date) and maintained by the CUWCD to document the public involvement activities associated with the planning of the SFN System. These eight volumes contain meeting agendas, minutes of meetings, and a list of those attending. The meetings were often held on a weekly basis at the initiation of the SFN System planning in 1992 and continued on a frequent basis, either weekly or monthly, through 1995. The meetings were held principally with the public and water organizations representing interests in eastern Juab County, southern Utah County, and the Sevier River Basin.

4.4 Scoping Process

4.4.1 Pre-Scoping Meetings

Pre-scoping meetings were conducted in February 1993 to brief agency representatives, potential water users, and the general public on the status of the planning process for the SFN System. The meetings were held in Richfield and Delta on February 23, in Nephi on February 24, and in Santaquin on February 25, 1993, and were attended by 157 people. Input from the pre-scoping meetings, numerous Area Planning Team meetings, and technical coordination meetings (see Section 4.5 for further discussion of these meetings) was used to develop several water delivery and use concepts that were refined into a set of alternatives to be presented to the general public and agencies as part of the scoping process.

4.4.2 Scoping Meetings

In planning the scoping meetings, consideration was given to the following overall objectives: 1) to seek public, agency, and special interest group concerns on needs, issues, alternatives, and potential impacts and opportunities to be analyzed in the SFN System EIS; 2) to identify existing information and studies that should be considered in the analysis; 3) to inform the public of the proposed SFN System's planning, public involvement, and decision-making processes; and 4) to obtain input from individuals, agencies, and special interest groups on how they would like to participate in the planning process.

Scoping meetings were held in Spanish Fork, Nephi, and Salt Lake City on September 28, 29, and 30, 1993, respectively. Details of the specific times and locations, the processes used to notify the public about the scoping meetings, results of the scoping process, and details on the written comments received during the scoping process are fully documented in the *Scoping Report for the I&D System Component of the Bonneville Unit of the Central Utah Project* (CUWCD 1994a), available upon request from Sheldon Talbot, Project Manager, 355 West 1330 South, Orem, Utah 84058.

4.5 Consultation and Coordination Activities

Interagency/intergovernmental coordination and consultation is an essential part of the EIS process. It provides a forum in which close working relationships are developed with agencies and organizations that are affected by or concerned about a proposed project. Similar to the public involvement process, a key objective of a consultation and coordination program is to provide an opportunity for agencies and organizations to participate in the investigation of project alternatives and provide input to decisions about specific project-related issues.

A consultation and coordination program was conducted for the SFN System in accordance with the policies and requirements set forth in CUPCA and NEPA. The consultation and coordination process included the participation of a wide range of interested individuals and resource agencies that could be affected by the construction and operation of the SFN System.

A list of those agencies with either jurisdictional authority, interest, or expertise in the activities or issues addressed for the SFN System is provided in Table 4-1. Representatives from these agencies were involved at each stage of the planning process, including participation in technical working sessions and monthly coordination meetings, as well as the review of detailed environmental field study work plans and technical reports for specific resource areas. These activities are described in further detail below.

Table 4-1
Agencies and Organizations That Participated in the SFN System Consultation and Coordination Process

Utah Division of Water Resources
Utah Division of Wildlife Resources
Utah State Historic Preservation Office (SHPO)
Natural Resources Conservation Service (NRCS)
U.S. Department of Interior (DOI)*
U.S. Fish and Wildlife Service (FWS)
U.S. Geological Survey (USGS)
U.S. Forest Service (USFS)
U.S. Army Corps of Engineers (COE)
U.S. Environmental Protection Agency (USEPA)
Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission)*
Strawberry Water Users Association
East Juab County Water Conservancy District (EJCWCD)
Utah County
Various Irrigation Companies
Utah Outdoor Interest Coordinating Council

*Co-sponsoring agency of the SFN System DEIS.

4.5.1 Technical Working Groups

Technical working groups were formed by the SFN System Planning Team to facilitate technical input from agencies and individuals within their specific areas of interest and expertise. The seven groups that were formed are shown in Table 4-2. Individual well owners and representatives from the EJCWCD, Utah Division of Water Resources, Utah Division of Wildlife Resources, NRCS, Agricultural Stabilization and Conservation Service, USGS, FWS, wildlife groups, Utah State University, the City of Nephi, and various irrigation companies participated in the technical coordination meetings that were held on an as-needed basis.

Table 4-2 SFN System Technical Work Groups
Land and Water Requirements
Conjunctive Use of Groundwater
Irrigation Distribution Systems
Wildlife Resources
Wetlands Habitat
Aquatic Resources
Cultural Resources

4.5.2 Agency Coordination Meetings

In addition to the technical coordination meetings, agency coordination meetings were held at CUWCD's office in Orem. The purpose of the meetings was to coordinate the ongoing studies undertaken by CUWCD and its consultants with studies being conducted by other agencies. These meetings differed from the SFN System Planning Team meetings in that they were more specifically concerned with the coordination of existing studies and the prevention of duplicated efforts by these agencies. These meetings were attended by representatives of the DOI, USEPA, FWS, USFS, NRCS, Utah Division of Water Resources, Utah Division of Wildlife Resources, COE, UOICC, Strawberry Water Users Association (SWUA), EJCWCD, and various other environmental groups.

These agency meetings began in 1992 and were held initially on a monthly basis. These meetings eventually evolved to irregular intervals from monthly to semiannually, depending on the phase of plan formulation or evaluation in progress. Regular monthly meetings were held when environmental study work plans were being prepared, when alternative plans were being formulated, and when technical reports were under review by cooperating agencies (see also Section 4.5.5).

4.5.3 Water User Meetings

Another vital element of the coordination process consisted of meetings with water user organizations regarding water allocations, delivery schedules, and integration of local supplies with Bonneville Unit water. These meetings were attended by water companies that plan to contract for Bonneville Unit water. Notably, the meetings with representatives of the SWUA to plan for the operational integration of the SFN System with the Strawberry Valley Project were numerous and were often conducted on a regular weekly basis. The meetings were supplemented by periodic attendance at various water users' board meetings by CUWCD representatives and by presentation of status reports on issues of interest to these agencies.

Similar meetings were also held with the Nephi Irrigation Company, Levan Irrigation Company, Mona Irrigation Company, and the Juab Lake (Mills) Irrigation Company. Additional field contacts were made with approximately 25 individuals, mostly representing the North Canyon Irrigation Company. These meetings were used to compile information on present and future cropping patterns, irrigation methods, water supply, irrigation systems, and irrigated lands. Input was also obtained on local objectives and desires for Bonneville Unit water.

4.5.4 Water Workshops

The CUWCD conducted four day-long SFN System Water Workshops to provide a public forum for discussing the operational integration of the SFN System with local water distribution systems. The workshops, which were held in Santaquin, Utah, on March 18, 1995, February 14, 1996, March 20, 1997, and March 19, 1998, were open to the public.

During these workshops, representatives of the SFN System Planning Team provided an annual update on the planning of the SFN System. Speakers from the NRCS gave presentations on methods to improve irrigation water use efficiency. Representatives of water companies addressed their preparations for distribution of Bonneville Unit water and rehabilitation of local distribution systems. Various individual irrigators participated by presenting their experiences and successes in conserving irrigation water through the use of sprinkler irrigation and other water-saving measures. The workshops also included speakers from federal and State agencies on subjects ranging from the area's agricultural economy to Utah's interest in, and assistance programs for, improving local water distribution systems.

4.5.5 Review of Work Plans and Technical Reports

4.5.5.1 Environmental Study Work Plans

As part of the SFN System environmental planning process, detailed environmental study work plans were developed for the specific resource topics involved in the SFN System, which are listed on Table 4-3. These work plans outlined the specific studies to gather information related to the issues and concerns identified during scoping, where applicable, and the methodology undertaken to analyze potential impacts on each resource. Agency staff were provided an opportunity to review and comment on all the work plans prior to implementation and completion of the environmental studies and analyses. The agencies that participated in the work plan review process are listed in Table 4-3.

4.5.5.2 Technical Reports

Upon completion of the data collection and analytical processes outlined in the individual work plans, draft technical reports were prepared for the resource areas shown in Table 4-4. Each technical report presented the results of the field studies and other data collection efforts, documented the analytical process, and discussed the full range of potential impacts on the resource from the construction and operation of the SFN System and distribution and on-farm systems. Both direct and indirect impacts were addressed as well as mitigation measures.

As part of the preparation process, agency review and comments on each technical report were sought. Preliminary drafts of each document were provided to those agencies requesting the document for review, first in November 1995 and again in June 1997. The agencies that participated in the technical report review process are listed in Table 4-4. The agency comments contributed to the preparation of the draft technical reports.

4.5.6 Review of Preliminary Drafts of the DEIS

The agencies listed in Table 4-1 reviewed the first preliminary drafts of the EIS. The first review occurred in November 1995, following which the reviewing agencies provided comments and suggestions in their areas of expertise to assist the CUWCD in assessing the adequacy of the analyses and preparing the Draft EIS. The second review occurred in June 1997, following the addition of two alternatives to the DEIS. The comments resulting from the second review led to changing the Proposed Action to include the "Diamond Fork Tunnel Alternative" as a substitute for Monks Hollow Dam and Reservoir.

4.6 Public Hearings on DEIS

Public hearings on this DEIS will be held to provide an opportunity for interested parties and agencies to present oral and written comments on this document and the proposed SFN System. A list of agencies, bureaus, and groups that will receive this DEIS is included in Appendix E.

Table 4-3
Environmental Study Work Plans

Work Plan	Reviewing Agencies	Agencies Providing Comments
Aquatics	UOICC, DOI, Utah Division of Wildlife Resources, FWS, USFS, COE, EPA	Utah Division of Wildlife Resources, FWS, EPA
Cultural Resources	DOI, UOICC, USFS	None
Threatened and Endangered Species	UOICC, Utah Division of Wildlife Resources, USFS, FWS, DOI	Utah Division of Wildlife Resources, USFS, FWS
Wetlands	COE, EPA, Utah Division of Wildlife Resources, NRCS, FWS, USFS, DOI, UOICC	EPA, Utah Division of Wildlife Resources, NRCS, FWS, USFS
Wildlife	UOICC, NRCS, Utah Division of Wildlife Resources, USFS, FWS, DOI	NRCS, Utah Division of Wildlife Resources, USFS, FWS
Agriculture	DOI, UOICC, NRCS, USFS, Utah Division of Water Resources	NRCS
Air Quality	UOICC, EPA, DOI	None
Health and Safety	DOI, UOICC	None
Mineral and Energy Resources	DOI, UOICC, NRCS, USFS, FWS	NRCS, FWS
Recreation/Visual	DOI, UOICC, USFS	DOI
Socioeconomics	UOICC, NRCS, DOI	NRCS
Soils	DOI, UOICC, NRCS, USFS	NRCS
Transportation/Land Use	DOI, UOICC, NRCS, USFS	NRCS
Vegetation	DOI, UOICC, NRCS, Utah Division of Wildlife Resources, USFS, FWS	NRCS, FWS
Water Resources	UOICC, NRCS, Utah Division of Wildlife Resources, USFS, EPA, Utah Division of Water Resources, FWS, DOI	NRCS, Utah Division of Wildlife Resources, FWS

Table 4-4
Agencies That Participated in Technical Report Review Process

Technical Report	Reviewing Agencies
Hydrology and Water Resources	Utah Division of Wildlife Resources, DOI, FWS, NRCS, Utah Division of Water Resources, USFS, UOICC, EPA, Mitigation Commission
Wetland Resources	NRCS, FWS, Utah Division of Wildlife Resources, USFS, UOICC, Utah Division of Water Resources, DOI, EPA, Mitigation Commission
Aquatic Resources	Utah Division of Wildlife Resources, DOI, FWS, NRCS, Utah Division of Water Resources, USFS, UOICC, EPA, Mitigation Commission
Wildlife Resources	DOI, FWS, Utah Division of Wildlife Resources, Utah Division of Water Resources, USFS, UOICC, NRCS, EPA, Mitigation Commission
Special-Status Species	DOI, FWS, Utah Division of Wildlife Resources, Utah Division of Water Resources, USFS, UOICC, NRCS, EPA, Mitigation Commission
Utah Lake Hydrology	USFS, NRCS, DOI, Utah Division of Wildlife Resources, SWUA, COE, EPA, UOICC, Mitigation Commission

Chapter 5

SHORT-TERM USE OF MAN'S ENVIRONMENT VERSUS MAINTENANCE OF LONG-TERM PRODUCTIVITY

Chapter 5
Short-Term Use of Man's Environment Versus Maintenance of Long-Term Productivity

5.1 Introduction

This chapter discusses the short-term use of man's environment that would be required to construct the SFN System versus the long-term productivity that would result from operation of the SFN System. This discussion is provided to present the rational behind utilizing resources that would be necessary to construct, operate and maintain the SFN System as described in this DEIS.

For the purposes of this chapter, short-term use of man's environment refers to either the actual use of resources during construction (e.g., energy, manpower and monetary investment) or impacts to resources (as described in Chapter 3) that would occur during construction or as a result of SFN System operation. Long-term productivity refers to the benefits that would be realized during operation of the SFN System. Short-term use (or impacts) of a given resource would not necessarily have a directly corresponding long-term benefit. For instance, potential short-term disturbance to big game during construction of the SFN System would not result in a long-term benefit to big game. Additionally, certain long-term adverse impacts would occur to some resources. These impacts are summarized, when appropriate, in this chapter.

The following sections discuss 1) the long-term productivity that would result from the operation of the SFN System, then 2) the short-term use of resources that would be required to realize long-term productivity.

5.2 Long-Term Productivity

Long-term benefits that would be realized from the operation of the SFN System include: 1) improved land values and increased agricultural productivity within lands eligible to receive Bonneville Unit water, 2) improved water distribution and application efficiencies, 3) increases in municipal and industrial water supplies, 4) establishment of minimum flows and reduced maximum flows in Sixth Water and Diamond Fork Creeks and the Spanish Fork River, 5) enhanced stream habitat and fisheries, and 6) enhanced recreational opportunities within the impact area of influence.

5.3 Short-Term Use of Resources

Resources that would be required for construction of the SFN System include construction materials, energy, manpower and monetary expenditure; specific requirements are discussed in Chapter 1. Additionally, short-term (temporary) impacts would occur to some resources during construction of the SFN System, as discussed in Chapter 3. The following discussion summarizes the short-term impacts to resources identified in Chapter 3 and, when applicable, discusses associated long-term productivity benefits. Short-term impacts and directly associated long-term benefits are shown in Table 5-1.

5.3.1 Water Quality

Construction activities at stream crossings could cause turbid conditions and a temporary decline in water quality. Following construction activities and the stabilization of these crossings, these crossings would no longer contribute sediment beyond present conditions. This short-term impact would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

Table 5-1 Summary Assessment of Short-Term Use Versus Long-Term Productivity		
Environmental Aspect	**Short-Term Impact**	**Direct Long-Term Benefit***
Water Quality	Turbidity from construction-related stream crossings	None
Wetland Resources	Temporary disturbance of wetlands habitat by construction activities	Additional wetland acreage would be provided to compensate for short-term impacts
Wildlife Resources	Temporary disturbance to wildlife and big game habitat	None
Aquatic Resources	Water quality degradation by silt during construction	None
Special-Status Species	Potential temporary disruption of eagle nesting in Diamond Fork drainage	None
Agriculture	Temporary restrictions on agricultural production within the Main Conveyance Aqueduct right-of-way	Increased agricultural productivity throughout the impact area of influence
Recreational Resources	Reduction in access to recreation sites in Diamond Fork drainage	Enhanced fisheries, flatwater fishery, and recreation
Air Quality/Noise	Temporary localized dust and noise created by construction	None
Cultural Resources	Disruption of historical/archaeological sites	Enhanced information data base
Visual Resources	Temporary visual impacts	None
Transportation	Temporary delays and road closures	Improved Diamond Fork Road under the Proposed Action, MCAPW-DFT, and No Action Alternatives.

*Indirect benefits are not listed in the table, but would include allowing for the development of the SFN System and the resulting productivity and other associated long-term gains.

5.3.2 Wetland Resources

Construction activities would cause a temporary localized disturbance to wetland habitat at stream crossings. Additional wetland habitat would be developed to mitigate for this short-term affect. The additional development of wetlands would result in the long-term benefit of increased net riparian habitat and would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

5.3.3 Wildlife Resources

Construction activities would result in a temporary short-term disturbance of wildlife habitat and wildlife in the vicinity of construction areas. Additionally, certain features would permanently disturb limited areas of wildlife habitat. While these impacts would not result in a long-term benefit to wildlife resources, they would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

5.3.4 Aquatic Resources

Turbid conditions in affected creeks that would result from construction activities in some locations could have a short-term impact on fish reproduction; potentially equivalent to a one-year suspension of all natural reproduction. However, the operation of the SFN System would result in the direct long-term benefit to aquatic resources by significantly enhancing fisheries through the establishment of minimum flows and reduced maximum flows.

5.3.5 Special-Status Species

Construction activities within the Diamond Fork drainage could deter eagles from using nearby nesting sites for up to two years. While this impact would not result in a long-term benefit to special-status species, it would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

5.3.6 Agriculture

Construction of the Main Conveyance Aqueduct would require the temporary restriction of agricultural practices and productivity within the right-of-way. Additionally, certain agricultural land practices would be permanently lost due to operational restrictions of the SFN System (e.g., orchards would not be replaced within the right-of-way). This limited disruption to agricultural activities within the right-of-way would allow the development of the SFN System resulting in the long-term benefit of increased agricultural productivity within the entire area of influence.

5.3.7 Recreational Resource

Construction activities within the Diamond Fork drainage would require short-term limitations on access to the area; thus reducing associated recreational opportunities. Long-term impacts would also occur under SFN System alternatives that would require the construction of Monks Hollow Dam and Reservoir, including the closure of Diamond Fork Road, the inundation of certain trail-heads and the inundation of portions of Diamond Fork Creek used by anglers. These disruptions to recreation would result in the long-term benefits of enhanced angling opportunities on area streams, the addition of a flat-water fishery (under alternatives that would require Monks Hollow Dam and Reservoir) within the Diamond Fork drainage and the addition of a recreation trail in southern Utah County (under the Proposed Action and MCAP Alternative).

5.3.8 Air Quality/Noise

Construction activities would result in temporary air emissions, short-term impacts to air quality, and temporary increases in noise levels. While these impacts would not result in a direct long-term benefit to air quality or the ambient noise environment, they would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

5.3.9 Cultural Resources

Construction activities could expose and disturb unknown historical or archeological sites. This would result in the long-term benefit of recording such sites and enhancing the NRHP database.

5.3.10 Visual Resources

Construction activities would cause short-term disturbances to the existing landscape and would temporarily detract from the scenic value of some areas. While there would be no direct benefit of this short-term impact, it would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

5.3.11 Transportation

Construction activities and construction traffic would result in temporary delays along some transportation routes in the area. Additionally, the closure of Diamond Fork Road (permanently under alternatives that would require Monks Hollow Dam and Reservoir), would cause short- and/or long-term transportation impacts. Direct benefits to transportation resources would occur under the Proposed Action and MCAPW-DFT and No Action Alternatives, as Diamond Fork Road would be improved during construction. Additionally, these impacts would indirectly allow for the development of the SFN System and the resulting long-term benefits identified in Section 5.2.

Chapter 6

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Chapter 6
Irreversible and Irretrievable Commitment of Resources

6.1 Introduction

The irreversible and irretrievable commitment of certain resources would be required to construct and operate the SFN System. Irreversible and irretrievable commitments would occur from the use of resources for the construction and operation of the SFN System and would also occur through impacts to resources as a result of SFN System construction and operation.

For the purposes of this document, the irreversible commitment of a resource means that following the decision to take certain actions which would result in the utilization or loss of a given resource (in part or in whole), either the decision could not be changed or the action could not be reversed due to physical or economical constraints. The irretrievable commitment of a resource is defined as the loss of future options and/or a given resource. Consequently, any resources used for either the construction and/or operation of the SFN System (as identified in Chapter 1) would be irretrievable commitments of a resource. Additionally, the loss of a resource resulting from an SFN System impact (as identified in Chapter 3) would be considered an irretrievable commitment of that resource. For example, once water is diverted from the Colorado River Basin into the Bonneville Basin, it cannot feasibly be retrieved, and this would be considered an **irretrievable** commitment of resources. However, the action to divert the water is not **irreversible**. If the legislative and policy decisions were made to not divert water from the Colorado River Basin, then diversion facilities could be reconfigured accordingly, and the commitment of resources would be reversed.

6.2 Irreversible and Irretrievable Commitments Resulting from the Use of Resources

Resources that would be used for the construction of the SFN System include: construction materials such as concrete and steel for pipes, tunnel linings, and other structures; energy resources such as oil and gas for construction vehicles and equipment; manpower; and monetary investment. These resources would also be required to a limited extent for the operation and maintenance of the SFN System. Chapter 1 provides details on the construction and operational materials requirements.

Each of the uses described above would result in irretrievable and irreversible commitments of these resources. Once these resources have been used for construction the decision to use them can not be reversed, nor can the resources be practicably retrieved.

6.3 Irreversible and Irretrievable Commitments Resulting from Impacts to Resources

Irreversible and irretrievable commitments would occur to resources as a result of adverse SFN System impacts. When appropriate, impacts were quantified in Chapter 3. Thus, this section does not attempt to repeat a quantitative discussion and is limited to a summary of relevant resource commitments. A summary of the issues involving irreversible and irretrievable commitment of resources is provided in Table 6-1.

Table 6-1
Summary of Issues Involving Irreversible and Irretrievable Commitment of Resources

Resource	Issue	Can the Commitment of Resources Be Reversed?/ Can the Resource Be Retrieved?						
		Proposed Action	MCAPW-DFT	MCAP	MCAPW	MCATC	MCAT	No Action
Construction Resources	Use of resources for construction, including materials, energy, manpower, and monetary investment	No/No	No/No	No/No	No/No	No/No	No/No	No/No
Water Resources	Diversion of water from Colorado River Basin	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
	Dedication of water for irrigation	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No*
Water Quality	Increased salinity of Utah Lake	Yes/NA	Yes/NA	Yes/NA	Yes/NA	Yes/NA	Yes/NA	Yes/NA
	Increased turbidity in Mona Reservoir	Yes/NA	Yes/NA	Yes/NA	Yes/NA	Yes/NA	Yes/NA	NA/NA
Wetland Resources	Permanent loss of wetlands	No/No	No/No	No/No	No/No	No/No	No/No	No/No
	Loss of wetlands due to changed flow regimes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
Aquatic Resources	Aquatic resource habitat losses	Yes/No	Yes/No	No/No	No/No	No/No	No/No	No/No
Special-Status Species	Direct loss of Ute ladies'-tresses colonies through inundation	Yes/No	Yes/No	No/No	No/No	No/No	No/No	NA/No
	Indirect loss of Ute ladies'-tresses through water table fluctuation	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Soils	Erosion losses	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Agricultural Resources	Productivity losses on agricultural lands by the Main Conveyance Aqueduct	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Recreational Resources	Reduced access to trails	NA/NA	NA/NA	No/No	No/No	No/No	No/No	NA/NA
Cultural Resources	Disturbance and/or losses of cultural resources	No/No	No/No	No/No	No/No	No/No	No/No	No/No
Transportation	Reduced access to upper Diamond Fork Canyon	No/No	No/No	Yes/Yes	Yes/Yes	Yes/Yes	No/No	No/No

*Under the No Action Alternative, most of the transbasin diversion would be for M&I use.

6.3.1 Water Resources

The SFN System would involve an irretrievable commitment of a portion of northern Utah's water supply for irrigation and M&I use in the Bonneville Basin. This water would originate in the Uinta Basin, from where it originally flowed to the Colorado River System prior to the construction of the Strawberry and Starvation Collection Systems. The commitment to divert water to the Bonneville Basin was made when those systems were constructed. This commitment would be fully utilized under the SFN System, including the No Action Alternative. The commitment of resources, however, is not irreversible and could be reversed upon a legal/regulatory change in policy.

Public comment during the scoping of the SFN System raised concerns over dedicating Bonneville Unit water from Strawberry River to primarily agricultural use in southern Utah and eastern Juab Counties, instead of making it available for M&I use in Salt Lake County. In the absence of the SFN System (or an alternative diversion plan) most of the Bonneville Unit water, after flowing through Starvation and Strawberry Reservoirs, would continue to flow into the Colorado River System until such time as the current allocation of M&I water had reached full utilization. Experience in the western United States has shown that the use of water for irrigation is not intrinsically irreversible. While there are presently no plans to convert Bonneville Unit irrigation water to M&I use, it would be physically possible to do so. Thus, while water used to irrigate eligible agricultural lands under the SFN System would be irretrievable, the commitment to provide an on-going agricultural water supply to those lands would not be irreversible.

6.2.2 Water Quality

The SFN System Proposed Action and action alternatives would increase the salinity of the water in Utah Lake and would increase the turbidity of waters in Currant Creek and Mona Reservoir. Increases in salinity would result from increased irrigation and M&I return flows to the Utah Lake. While salinity increases would not significantly affect the usefulness of the water for irrigation, it could increase the cost of treating the water for M&I uses. These impacts could be reversed by eliminating the use of Bonneville Unit water for agricultural irrigation south of Utah Lake.

The No Action Alternative would not affect Mona Reservoir or Currant Creek and would improve the water quality of Utah Lake from current conditions because most of the high quality Bonneville Unit water diverted from Strawberry Reservoir would not be used for agricultural purposes and would flow directly to Utah Lake.

6.2.3 Wetland Resources

Each of the SFN System alternatives would result in the loss of certain wetlands. A permanent loss of wetlands would be considered both an irretrievable and irreversible commitment; however, mitigation would be undertaken to replace lost wetlands. The Proposed Action and all of the action alternatives would be accompanied by related actions (local development) that would include conversion of numerous open canals and ditches to closed pipelines. The open canals and ditches currently support wetland habitat through seepage and by raising the adjacent groundwater table to the extent that it supports wetland vegetation. Wetlands impacts that would occur due to operational flows would not be considered irreversible, as flow regimes could be altered to restore original flows and original wetland conditions.

6.2.4 Aquatic Resources

Implementation of the MCAP, MCAPW, MCATC, and MCAT Alternatives would cause the irreversible loss of stream habitat along 2.5 miles of Diamond Fork Creek due to inundation from Monks Hollow Reservoir. With construction of the No Action Alternative, 0.6 mile of Diamond Fork Creek would be inundated by Three Forks Reservoir. These losses of stream habitat would be considered irreversible and any impacts to (i.e., losses of) aquatic resources would be irretrievable. Under the Proposed Action and MCAPW-DFT changes in flows could be reversed; however, any impacts to (i.e., losses of) aquatic resources would be irretrievable.

6.2.5 Special-Status Species

The Proposed Action is likely to result in the permanent loss of certain colonies, or parts of colonies, of Ute ladies'-tresses (*Spiranthes diluvialis*). This member of the orchid species inhabits riparian soils that lie in a narrow range of elevations above stream water surfaces in some areas within the impact area of influence. The SFN System would affect colonies of this species through changes in groundwater elevations and through physical disturbance. Individual plants lost would be irretrievable; however, habitat lost could be restored and would not be considered irreversible.

Permanent disturbance would occur under the four action alternatives that would require the construction of Monks Hollow Dam and Reservoir. A small colony of Ute ladies'-tresses would be destroyed by construction equipment at the Monks Hollow Dam site, and the filling of the reservoir would inundate a colony upstream of Monks Hollow. While mitigation would be provided, the loss of individual colonies and the permanent loss of habitat would be considered irreversible and irretrievable commitments.

6.2.6 Soils

Increased soil erosion rates could occur as a result of construction disturbance and changes in flow regimes. Soils lost to erosion would be irretrievable; however, long-term erosion effects of SFN System flow regimes could be reversed.

6.2.7 Agricultural Resources

Construction of the Main Conveyance Aqueduct under the Proposed Action and all action alternatives would require clearing some agricultural lands along the right-of-way. This would result in the irretrievable loss of some agricultural production. This would not be an irreversible commitment because this land could be returned to agricultural production.

6.2.8 Recreational Resources

The implementation of the MCAP, MCAPW, MCATC, MCAT, and No Action Alternatives would result in permanent adverse effects on recreational access within the Diamond Fork drainage. Impacts would occur to hiking, horseback, and mountain biking trails currently accessed at Three Forks, resulting from the construction of Monks Hollow Dam and inundation of the area by Monks Hollow Reservoir. While a trail is proposed around the southern side of Monks Hollow Reservoir that would provide access to trails on Cottonwood and Sixth Water Creeks, the ease of reaching certain destinations in Sixth and Fifth Water Canyons would be greatly reduced. The interruption and loss of recreational access resulting from Monks Hollow Dam and Reservoir would be considered an irreversible and irretrievable commitment of recreational resources. The Proposed Action, the MCAPW-DFT Alternative, and the No Action Alternative would not have permanent adverse affects on recreational opportunities in the Diamond Fork drainage.

6.2.9 Cultural Resources

Although any cultural resources affected by the SFN System would be mitigated, any disturbance or removal of resources would be irreversible and irretrievable.

6.2.10 Transportation

The implementation of the MCAP, MCAPW, MCATC, and MCAT Alternatives would cause the irreversible closure of Diamond Fork Road beyond Monks Hollow. Blockage of Diamond Fork Road at Monks Hollow would reduce the accessibility of the upper Diamond Fork Canyon. Using alternate routes would increase travel time to that area for many visitors. This impact to transportation resources is considered both irreversible and irretrievable.

The Proposed Action, the MCAPW-DFT Alternative and the No Action Alternatives would not have permanent adverse effects on transportation in the Diamond Fork drainage.

The Proposed Action, the MCAPW-LIT Alternative and the no Action Alternative [illegible] adverse effects on [illegible] at the Diamond Fork drainage.

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GLOSSARY
ABBREVIATIONS AND ACRONYMS
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Glossary

Acidity. The state, quality, or degree of being acid; specifically waters or soils with a pH of less than 7.0.

Acre-feet. The volume of water that would cover one acre of land to a depth of one foot.

Aeration. Any active or passive process by which intimate contact between air and liquid is assured, generally by spraying liquid in the air, bubbling air through water, or mechanical agitation of the liquid to promote surface absorption of air.

Algal blooms. Relatively sudden acceleration in growth of algae in waters due to excess nutrients being infused into the system.

Alkalinity. The degree of intensity of soluble mineral salts in soil or water, specifically causing the pH to be greater than 7.0. Alkalinity represents the carbonates, bicarbonates, hydroxides, and occasionally the borates, silicates, and phosphates in the water.

Alluvial fan. Concentrations of sediment in fan-shaped patterns, formed where a stream enters an area of flatter slope, or emerges from a confined channel and is able to spread its sediment load laterally.

Alluvium. Clay, silt, sand, gravel, or similar detrital material deposited by running water.

Anaerobic process. A process occurring in the absence of molecular oxygen.

Anhydrite deposits. Deposits of a mineral $CaSO_4$ consisting of an anhydrous (free from water) calcium sulfate that is usually massive and white or slightly colored.

Anoxic soil. Soils that are oxygen deficient, probably because of prolonged water saturation.

Aquifer. Saturated permeable material that yields economical quantities of water to wells and springs.

Aquifer parameters. Properties of aquifers that are represented or measured with numeric values. Examples include transmissivity, specific yield, and storage coefficient.

Aquifer tests. A test to delineate aquifer parameters involving the withdrawal of measured quantities of water from or addition of water to a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition.

Arable. Soil fit for, or cultivated by, plowing or tillage.

Area-capacity curve. A plot of the relationship between the capacity and surface area of a reservoir.

Average annual flow. The sum of the monthly average flows, divided by 12 months. It can be calculated for one year, or as an average of all the years in the period of record.

Base flows. Most commonly refers to the component of streamflow that is relatively constant from year to year, in contrast to the total flow that is affected by snowmelt and rainfall.

Bioaccumulation. An increasing uptake and assimilation of chemical toxins through a food web or by individual animals within a food web.

Biota. The plant and animal life of a region or ecosystem, as in a stream or other body of water.

Braided. A term used to describe a stream that has formed several interlacing channels.

Buffering capacity. The ability of a solution to resist change in hydrogen-ion concentration (pH) upon the addition of small amounts of acids or bases. Well-buffered waters contain mixtures of weak acids and their salts or weak bases and their salts.

Burraston Ponds. Preferred local spelling. U.S. Forest Service prefers Burriston Ponds.

Calibrate. To adjust a model so that it simulates historical conditions (before using it to predict future conditions).

Calibration period. The time period over which the calibration is conducted.

Chironomid larvae. The larval stage of a family of midges that lack piercing mouthparts.

Cienegas. Spanish term for wet meadows.

Cofferdam. A temporary watertight enclosure from which water is pumped to expose the bottom of a body of water and permit construction.

Coliforms. Several types of bacteria that are somewhat harmless in themselves, but are used as pollution indicators. "Total coliforms" include all types. Fecal coliforms are the types which grow on fecal matter.

Colluvial. Accumulations along valley margins, of deposits derived from slope processes and extending up the hillsides above the valley bottoms.

Conductivities. The quality of living matter responsible for the transmission of and progressive reaction to stimuli.

Confined aquifer. An aquifer in which the groundwater is isolated from the atmosphere by impermeable geologic units; confined groundwater is generally subject to pressure greater than atmospheric.

Conterminous. Having a boundary in common; contiguous.

Cubic feet per second. A measurement of flow: volume/time, in English units.

Cyprinid. Relating to a classification of fish that includes minnows and carp.

Dead storage. The portion of a reservoir that cannot be utilized for releases because it is below the outlet. Also called "dead pool."

Degradation. Decline of conditions that support a particular natural system, species, or environment.

Denitrification. A process by which nitrate, a contaminant in water, is reduced to nitrous oxide or nitrogen which can then be driven out of the water by off-gassing.

Desiccation. Evaporation of water from a material. Drying out.

Detritus. Finely divided settleable material suspended in water.

Diatoms. A group of algae that serves as an important food source.

Discharge. The amount of water taken out of a hydrologic system or feature.

Dissolved oxygen. The amount of free (not chemically combined) oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation.

Eddies. Localized areas in streams, creeks, and rivers where water flows in the opposite direction of the main current.

Effluent. A liquid waste discharge (treated or untreated) from a manufacturing or treatment process.

Electrical conductivity. A measure of the ease with which a conducting current flows through a material under the influence of an applied electric field. It is the reciprocal of resistivity and is measured in mhos per foot.

Electrofishing. A technique for fish sampling whereby an electric current is applied to a water body at a regulated rate to temporarily immobilize fish.

Electrophoresis. The motion of charged particles through a relatively stationary liquid under the influence of an applied electrical force.

Element occurrences. Formal name used by the Utah National Heritage Program to specify species locations.

Endemic. Naturally occurring species; native species to a region.

Environmental Impact Statement. A detailed statement of environmental impacts caused by an action, written as required by the National Environmental Policy Act.

Equilibrate. To bring into, or keep, in equilibrium.

Estuaries. A water passage where the tide meets a river current.

Eutrophication. A condition in lakes whereby aquatic plants are abundant and water become deficient in oxygen. The process is usually accelerated by enrichment of waters with surface runoff containing nitrogen and phosphorus.

Eutrophication indicator. A constituent in water that can be used to indicate potential for eutrophication. Phosphorus above 2.0 mg/L is commonly thought to indicate a eutrophication hazard.

Evapotranspiration. The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants.

Extant. Located out of an area.

Extirpated. A species that is no longer found in a particular area but which exists in other locations.

Eyrie. A nesting site of birds of prey (e.g. eagles and falcons), usually located on a cliff or mountaintop.

Friable. Easily crumbled or pulverized.

Gaging station. A permanent facility on a stream which measures the depth (also called stage) of the water in the river. Depths are then converted to flows using a stage-discharge equation that has been developed for that particular site.

Generalist species. A species that is able to tolerate different habitats and is, therefore, found in a range of habitat conditions.

Geomorphic. Relating to the form of the earth or its solid surface features.

Groundtruth. Verification of aerial photointerpretation by observers on the ground.

Groundwater divide. A boundary in an aquifer where water flows in approximately opposite directions on either side of the divide. Similar to a drainage basin divide for surface waters.

Groundwater recharge. The process of adding water to the zone of saturation; also, the amount of water added.

HEC-2. U.S. Army Corps of Engineers' computer model used to calculate river water surface elevation.

Herbaceous. With the characteristics of an herb; a plant with no persistent woody stem above ground.

Hibernacula. Areas, such a burrows or caves, that provide areas for hibernation.

Highlands. The bench areas on the Wasatch Mountain front, above about 4,600 feet in elevation.

Holarctic. The biogeographic region including the Old and New Worlds and comprising the Nearctic and Paleartic regions or subregions.

Holotype. The single specimen designated by an author as the type of a species or lesser taxon at the time of establishing the group.

Hybridized. Species closely related which have characteristics intermediate between two species.

Hybridization. The genetic process of closely related species having intermediate characteristics between two species.

Hydraulic conductivity. The rate of flow of water through a cross section of a unit area under a unit hydraulic gradient, at the prevailing temperature. Commonly expressed in gallons per day per square foot.

Hydric. Characterized by, relating to, or requiring an abundance of moisture.

Hydroelectric. The production of electricity by water power.

Hydrograph. A graph of stage (level or depth) or discharge (volume/time) versus time.

Hydrologic feature. Elements of a hydrologic system (such as a lake, stream, or groundwater basin).

Hydrologic process. Process governed by the transportation, storage, or alteration of water.

Hydrologic regime. A characteristic condition of a river system in which the flow, volume, and sediment discharge are in equilibrium.

Hydrologic system. A related grouping of hydrologic features and processes within defined boundaries.

Hydrophytic. Characteristic of plants that grow in water.

Hydropower. Hydroelectric (or water-generated) power.

Hydrostatic. Dealing with fluids at rest and under pressure.

Hypereutrophic. A highly productive body of water that is often subject to algal blooms or oxygen depletion.

Impermeable. The inability of a porous rock, sediment or soil to transmit a fluid; the relative difficulty to create fluid flow under unequal pressure.

Inflow. The act or process of flowing in or into; something that flows in or into.

Interbedded. Sediments with relatively thick alternating layers of different lithologic material.

Lacustrine. Pertaining to, produced by, or inhabiting a lake.

Lacustrine deposits. Geologic material that was deposited in a lake environment.

Leaching. The removal of materials in solution from the soil.

Lentic. Relating to slow flowing water.

Levels of development. The land and water use and associated human developments on an area.

Lotic. Relating to fast moving areas of streams, creeks, or rivers.

Macrohabitats. Specific niches within a larger habitat type that supports a limited number of species.

Macroinvertebrates. An aquatic invertebrate large enough to be visible by an unaided eye.

Main Conveyance Aqueduct Pipeline. The SFN System Pipeline from the terminus of the Diamond Fork Pipeline to the terminus of the SFN System Pipeline. It does not include distribution system water conveyance to on-farm areas.

Micromhos. A unit of measure for electrical conductivity of water (Mmho).

Mountain front recharge. Recharge that is derived from precipitation on mountains adjacent to the groundwater basin. This recharge can occur as underflow from the mountains or as surface runoff that percolates when it reaches the valley fill.

Municipal and industrial water. A water use classification that designates water to be used for domestic, commercial, or industrial purposes.

National Environmental Policy Act. A congressional act requiring an environmental impact statement on all major federal actions significantly affecting the quality of the human environment. [42 U.S.C. 4332 2(2)(C).]

Nephelometric. A method of measuring turbidity in a water sample by passing light through the sample and measuring the amount of light that is deflected.

Nitrate. A chemical compound having the formula NO_3^-. Nitrate salts are used as fertilizers to supply a nitrogen source for plant growth. Nitrate addition to surface waters can lead to excessive growth of aquatic plants.

Nonattainment. An area which does not meet air quality standards set by the Clean Air Act for specified localities and periods.

Nonpoint source pollution (NPS). Water pollution that cannot be traced back to a single source. An example is pollution caused by erosion.

Off-farm wetland. Wetlands downgradient of on-farm areas.

Omnivore. An animal that feeds on both plants and other animals.

Operations model. Mathematical representations of the operation of a system.

Organochloride pesticide residue. A measurable concentration of residue (chloride based) of organochloride pesticide (e.g., DDT, Lindane, Chlordane) that can accumulate and persist in animal tissue.

Outflow. Something that flows out.

Oxidizing conditions. Conditions that allow oxidation, the process whereby an element is combined with oxygen and electrons are lost.

Per capita. Per unit of population, generally referring equally to each individual.

Perched water. Unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone.

Percolation. Seepage of surface water into the ground.

Perennial. Lasting throughout the whole year.

Permissible Exposure Limits. (above which there would likely be adverse biological effects) 3.3-11

Phosphorus. A nonmetallic element of the nitrogen family that occurs widely especially as phosphates.

Phreatophyte. A plant deriving its water from the water table; commonly used to describe nonbeneficial, water-loving vegetation that transpires excessive amounts of water.

Phytoplankton. Minute, free-floating aquatic plants.

Piscivorous. Fish-eating animals.

Plankton. The passively floating or weakly swimming minute animal life.

Pleistocene. Geologic time period (11,000 to 1.6 million years ago).

Potable. Determined to be suitable for drinking.

Point-source pollution. Water pollution that can be traced to a single source. An example is pollution caused by industrial discharge into a river.

Precocial. Animals able to move about at or shortly after birth.

Predation. One organism feeding off another.

Project years. A 44-year sequence of years, the first being the date of the start of full operation of the SFN System. Historic precipitation runoff and climatic conditions that occurred from 1930 to 1973 are assumed to be repeated in project years 1 to 44.

Quaternary. Geologic time period (in the last 1.6 million years).

Raptor. Bird of prey.

Reaches. A specified section of a river or a pipeline.

Recharge. The addition of water to the zone of saturation; also, the amount of water added.

Reducing conditions. Conditions which allow reduction, in which electrons are gained by an element or compound.

Refugia. Areas that provide protective cover or shelter.

Riparian. Relating to or living or located on the bank of a natural watercourse such as a river, lake, or tidewater.

Riprap. A foundation or sustaining wall of stones or chunks of concrete thrown together without order usually on an embankment slope to prevent erosion.

Riverine. Living or situated on the banks of a river.

Rotenone. A crystalline insecticide that is of low toxicity for warm-blooded animals and is used as an insecticide.

Saline playas. A type of wetland that is characterized by sparse vegetation and high soil salinity.

Salinity. The concentration of dissolved "salts" in the water, measured by Total Dissolved Solids (TDS).

Salmonids. A family of long-bodied, soft-finned fish species (trout and salmon).

Salt balance. An accounting of inflows and outflows of salts and the resulting change in salt content.

Selenium. A nonmetallic element linked to various animal maladies when absorbed in high concentrations.

Simulation period. The time period over which a model simulation is run.

Sodium absorption ratio. A mathematical relationship between sodium, calcium, and magnesium that estimates the ability of a soil to absorb sodium. Excess absorbed sodium promotes the dispersion of swelling clays reducing the soils capacity to hold and transmit water and air. Also called "sodic hazard."

Specific yield. The ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity to the volume of that mass, stated as a percentage, equal to the storage coefficient in unconfined aquifers.

Standing crop. The minimum biomass of fish typically found in a given stream. The common assumption is that this minimum biomass occurs in early fall after angler harvest and low summer flows have minimized the fish population.

Steppe. Arid land with vegetation requiring very little water, found usually in regions of extreme temperature range; soil that is buff to brown loam and generally deposited by wind.

Storage. The volume of water in a reservoir or in an aquifer.

Storage coefficient. The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Stratification. The act or process of layering of various types of soil or rock.

Substrate. The base on which an organism lives.

Surrogate. One that serves as a substitute, or in place of another.

Tertiary. Geologic time period (1.6 to 66 million years ago).

Thermocline. The boundary commonly formed in deep reservoirs and lakes between distinct zones of different temperatures, the hypolimnion (lower layer) being colder, stagnant, and oxygen-deficient and the epilimnion (upper layer) being oxygenated.

Total dissolved solids (TDS). The mass of dissolved ionic compounds in water per volume of water, usually expressed in mg/L or equivalently parts per million.

Transmissivity. A rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Expressed in units of volume divided by time and length (commonly, gallons per foot per day).

Trophic level. One of the hierarchical strata of a food web characterized by organisms which are the same number of steps removed from the primary producers.

Turbidity. The ability of water to transmit light. Suspended solids, organics, and dissolved species which color the water contribute to turbidity.

Turbulent flow. Flow characterized by random fluctuations in fluid velocity and by intense mixing of the fluid on the macroscopic level.

Underflow. Groundwater flow across a specified boundary.

Ungulate. A mammal having hoofs such as horses, cows, and swine.

Valley fill. Sediments that accumulate in a pre-existing valley structure.

Water balance. Also called a water budget. An accounting of inflows, outflows, and the resulting changes in storage over time.

Water diversion. Sometimes used to denote a place where water is diverted from a river or reservoir.

Water quality indicator. Water quality parameters that allow a broad characterization of water quality. For example, coliform count in the water is used as a general "pollution" indicator, since high levels of coliforms can be traced to untreated animal and human wastes.

Water year. The water year starts October 1 and ends September 30. For example, the 1995 water year started October 1, 1994, and ended September 30, 1995.

Well interference. The hydraulic effect that a pumping well has on the water level and/or yield of another well.

Abbreviations and Acronyms

Abbreviation/Acronym	Meaning/Description
AADT	average annual daily traffic
AAHU	average annual habitat units
ac-ft or A.F.	acre-foot/feet
ACP	Agricultural Conservation Program
AD/YR	angler days per year
ACHP	Advisory Council on Historic Preservation
ARDP	Agricultural Resource Development Program
ARF	agricultural return flows
ASCS	Agricultural Stabilization and Conservation Service (see also FSA)
BEBR	Bureau of Economic and Business Research
Binns HQI	Binns Method Habitat Quality Index
BLM	U.S. Bureau of Land Management
BOD	biological oxygen demand
bu	bushel
°C	degrees celsius
CADD	computer-aided drawing and design
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeters
CO	carbon monoxide
COE	U.S. Army Corps of Engineers
CFSA	Consolidated Farm Service Agency
CRP	Conservation Reserve Program
CRSP	Colorado River Storage Project
Credit Program	Water Conservation Credit Program
CUP	Central Utah Project

Abbreviation/Acronym	Meaning/Description
CUPCA	Central Utah Project Completion Act
CUWCD	Central Utah Water Conservancy District
CVWRFB	Central Valley Water Reclamation Facility Board
CVWRP	Central Valley Water Reuse Project
D	unquantified decrease
dB	decibel
dBA	A-weighted decibel
DC	direct current
DDT	dichloro-diphenyl-trichloroethane
DDE	dichlorophenyl-dichloroethane
DEIS	Draft Environmental Impact Statement
DEQ	Utah Department of Environmental Quality
diam	diameter
DO	dissolved oxygen
DOI	U.S. Department of Interior
DPR	Definite Plan Report
DSC	distribution system construction
EC	electrical conductivity
EIS	Environmental Impact Statement
EJ	East Juab
EJCWCD	East Juab County Water Conservancy District
EJWEP	East Juab Water Efficiency Project
E.O.	element occurrences
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FDM	fugitive dust model
FEIS	Final Environmental Impact Statement
fps	feet per second
FSA	Farm Service Agency (see also ASCS)

Abbreviation/Acronym	Meaning/Description
ft	foot/feet
ft^3	cubic feet
ft/mi	feet per mile
FWS	U.S. Fish and Wildlife Service
GDP	Gross Domestic Product
GIS	Geographic Information System
gpd	gallons per day
gpm	gallons per minute
Guides	On-Farm Habitat Utilization Guides
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HEC-2	COE's hydraulic engineering model
HQI	Habitat Quality Index
I	unquantified increase
I-15	Interstate 15
I&D System	Irrigation and Drainage System
IABAT	Interagency Aquatic Biological Assessment Team
IFIM	Instream Flow Incremental Methodology
in	inch/inches
km	kilometer
KOP	key observation point
kV	kilovolt
kWh	kilowatt-hour
lb	pound
lb/day	pounds per day
M&I	municipal and industrial
M&I System	Municipal and Industrial System
MAG	Mountainland Association of Governments
MCAP	Main Conveyance Aqueduct with Monks Hollow Dam Alternative

Abbreviation/Acronym	Meaning/Description
MCAPW	Main Conveyance Aqueduct with Monks Hollow Dam and Without SVP Water Conveyance Alternative
MCAPW-DFT	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative" and Without SVP Water Conveyance Alternative
MCAT	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam and Without SVP Water Conveyance Alternative
MCATC	Main Conveyance Aqueduct with Loafer Mountain Tunnel and Monks Hollow Dam Alternative
m	meter
mg/L	milligrams per liter
min	minimum
Mitigation Commission	Utah Reclamation Mitigation and Conservation Commission
ml	milliliter
mm	millimeters
mph	miles per hour
MPN	most probable number
msl	mean sea level
MW	megawatt(s)
N	nitrogen
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NH_3	ammonia
nm	not measurable
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrous oxide
NO_2	nitrogen dioxide
NOI	Notice of Intent
NPS	National Park Service
NQ	not quantified
NRCS	Natural Resources Conservation Service, formerly SCS
NRHP	National Register of Historic Places

Abbreviation/Acronym	Meaning/Description
NTCHS	National Technical Committee for Hydric Soils
NTU(s)	nephelometric turbidity unit
NWI	National Wetlands Inventory
O_3	ozone
OPB	Utah State Office of Planning and Budget
OSHA	Occupational Health and Safety Administration
P	phosphorus
Pb	lead
PC	project construction
pH	presence of hydrogen (measure of acidity)
PM_{10}	particulate matter smaller than 10 microns
PO	project operation
ppm	parts per million
ppt	parts per thousand
Proposed Action	Main Conveyance Aqueduct with "Diamond Fork Tunnel Alternative"
ROG	reactive organic gases
RPA	reasonable and prudent alternatives
RTU	remote telemetry unit
SCADA	Supervisory Control and Data Acquisition System
SCIC	Summit Creek Irrigation Company
SCS	Soil Conservation Service, now known as NRCS
SFN System	Spanish Fork Canyon-Nephi Irrigation System
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
sq mi	square mile
SR	state route
SVP	Strawberry Valley Project
SWUA	Strawberry Water Users Association
T	temperature
TDS	total dissolved solids

Abbreviation/Acronym	Meaning/Description
TES	threatened, endangered, and sensitive
Turb	turbidity
UBRP	Uinta Basin Replacement Project
UDEQ	Utah Department of Environmental Quality
UDNR	Utah Department of Natural Resources
UDOT	Utah Department of Transportation
$\mu g/m^3$	micrograms per cubic meter
UNHP	Utah National Heritage Program
UOICC	Utah Outdoor Interest Coordinating Council
USBR	U.S. Bureau of Reclamation
USC	United States Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VQO	visual quality objective
WCWEP	Wasatch County Water Efficiency Project
WE	Wetland Evaluation Technique
WMIS	Water Management Improvement Studies
WQ	water quality
µmhos/cm	micromhos per centimeter

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Appendix A

Erosion Control, Revegetation, and Maintenance Plan

Appendix A
Erosion Control, Revegetation, and Maintenance Plan

A.1.0 Applicability

The Erosion Control, Revegetation, and Maintenance Plan applies to all portions of the Spanish Fork Canyon-Nephi Irrigation System (SFN System) that would be constructed by the Central Utah Water Conservancy District (CUWCD). The intent of this plan is to minimize project-related disturbance in the construction right-of-way, extra work areas, contractor storage yards, and access roads, as well as to minimize erosion and to enhance revegetation in any disturbed areas.

A.2.0 Pre-Construction Planning

A.2.1 Drain Tile and Irrigation Systems

Contact landowners to locate fields containing drainage tiles and irrigation systems.

A.2.2 Road Crossings and Access Points

Plan for safe and accessible conditions at all roadway crossings and access points during construction and restoration.

A.2.3 Disposal Planning

Determine methods and locations for disposal of slash and excess rock. Off-site disposal would comply with all applicable survey and mitigation requirements.

A.2.4 Agency Coordination

Develop specific procedures in coordination with the appropriate agencies to assure successful revegetation of chosen plant species.

A.3.0 Installation

A.3.1 Approved Areas of Disturbance

The construction right-of-way described in Chapter 1 of the Draft Environmental Impact Statement (DEIS) would be used. However, additional construction right-of-way area could be used in limited areas for full right-of-way width topsoil segregation or where topographic conditions, such as sideslopes, require it to ensure safe construction.

A.3.2 Topsoil Segregation

Topsoil would be separated from subsoil by stripping off only the topsoil layer. This would be performed along the entire right-of-way. In residential areas, topsoil replacement (i.e., importing topsoil) could be used as an

alternative to topsoil segregation. Gaps would be left in topsoil piles where drainage occurs. Topsoil would not be piled in a manner that increases water content. Topsoil stripping activities would cease during excessively wet weather. Topsoil would not be stockpiled for periods longer than one year.

A.3.3 Tunnel Spoil Disposal

Waste material (tunnel muck) from tunneling operations would be disposed in areas near tunnel portals and graded and shaped to match the natural topography to the extent feasible. Spoil will be revegetated as described in Section A.8.4 below.

A.4.0 Drain Tiles

Drain tile locations identified during construction would be marked. All drainage tile systems within the area of disturbance would be probed to ensure they remain undamaged. All drainage tiles would be restored to their original condition. Qualified specialists would be used for any necessary tests and repairs.

A.5.0 Irrigation

Water flow in crop irrigation systems would be maintained. If necessary, shutoff would be coordinated with affected parties.

A.6.0 Road Crossings and Access Points

Safe conditions would be maintained at all road crossings. If crushed stone access pads are used in residential or active agricultural areas, the stone would be placed on synthetic fabric to facilitate removal.

A.7.0 Temporary Erosion Control

A.7.1 Temporary Slope Breakers

Temporary slope breakers are intended to reduce runoff velocity and divert waste from the construction right-of-way. Temporary slope breakers would be constructed of such materials as soil, silt fence, staked hay or straw bales, or sandbags.

Slope breakers would be constructed using the written recommendations of the local soil conservation authorities. In the absence of these recommendations, temporary slope breakers would be installed at the following spacing:

Slope	Spacing
5% to 15%	300 feet
More than 15% to 30%	200 feet
More than 30%	100 feet

Slope breakers would be constructed with a 2 to 8 percent outslope to divert surface flow to stable areas. In the absence of a stable area, appropriate energy-dissipating devices would be built. Slope breakers would comply with all applicable survey requirements if they extend beyond the edge of the construction right-of-way.

The outfall would be directed to a stable, well-vegetated area. If necessary, energy-dissipating devices would be built at the end of the slope breaker.

A.7.2 Sediment Barriers

Sediment barriers would be installed to keep wetlands and water bodies free of possible sedimentation resulting from construction. The barriers would be constructed of materials such as silt fence, staked hay or straw bales, or sandbags. The sediment barriers would be installed as necessary at the base of slopes adjacent to road crossings and at construction locations near water bodies or wetlands where siltation could occur.

A.7.3 Mulch

Mulch could be used on sites with low annual precipitation or high erosion potential, on slopes exceeding 15 percent, or on windy sites. Mulch can consist of noxious weed-free straw or hay, erosion control fabric, or some functional equivalent.

Mulch would be applied before seeding if final cleanup, including final grading and installation of permanent erosion control measures, is not completed in an area within 10 days after the trench has been backfilled or if construction or restoration activity has been delayed for extended periods, such as a seeding period restriction.

Straw mulch would be applied at a rate of 1 ton per acre on level ground. On all dry, sandy sites and sites with slopes greater than 8 percent, mulch should be spread over at least 75 percent of the ground surface at a rate of 2 tons per acre. If slopes are within 100 feet of water bodies and wetlands, mulch should be increased to 3 tons per acre. When woodchips are used as a mulch, a maximum of 1 ton per acre should be used with 11 pounds per acre of available nitrogen also added. At least 50 percent of the nitrogen should be slow release.

Mulch would be anchored to aid the stabilization of erodible soils. A mulch crimper or disk with notched/coulters could do this, crimping the mulch to a depth of 2 to 3 inches. If a mulch blower is used, mulching materials should be at least 8 inches long to allow anchoring. Liquid mulch binders would be used at recommended manufacturer rates and would not be used within 100 feet of wetlands or water bodies.

Erosion control fabric, such as jute thatching or bonded fiber blankets, would be used on water body banks during final recontouring or on extremely steep slopes. The fabric would be anchored with staples or other anchoring devices.

A.8.0 Restoration

A.8.1 Cleanup

Final cleanup of an area (including replacement of topsoil, final grading, and installation of permanent erosion control structures) would be completed within 10 days after backfilling. If unavoidable delays occur, final cleanup would be completed as soon as possible and always prior to the end of the next recommended seeding season.

If necessary, a travel lane could be left open to allow access by construction traffic. When access is no longer required, the travel lane would be removed and the right-of-way restored.

Cleanup

For all rotated and permanent cropland, pastures, residential areas, and other areas, excess rock from at least the top 12 inches of soil would be removed at the landowner's request to the extent practicable. If replaced, rock would be of similar size, density, and distribution to that in adjacent areas.

After construction, soil would be replaced and worked with a disc, chisel plow, or other appropriate implement to reduce compaction and leave soil in proper revegetation condition. Topsoil should be replaced with a minimum of handling.

A.8.2 Permanent Erosion Control Devices

Trench breakers would be built to stop the flow of subsurface water along trenches. Trench breakers would be constructed of such materials as concrete, sandbags, or polyurethane foam. Topsoil would not be used in trench breakers.

When necessary, an engineer or similarly qualified professional would determine the need for and spacing of trench breakers.

In agricultural fields and residential areas where slope breakers are not typically required, trench breakers would be installed at the same spacing as permanent slope breakers.

Trench breakers would also be installed at the base of slopes adjacent to water bodies and wetlands.

A.8.3 Soil Compaction Mitigation

Topsoil and subsoil would be tested for compaction at regular intervals in agricultural and residential areas. To determine approximate preconstruction conditions, tests would be conducted on undisturbed areas with similar moisture conditions.

If necessary, a paraplow or other deep tillage implement would be used for compacted areas. Subsoil would be plowed before any segregated topsoils are replaced. Alternatively, arrangements would be made with the landowners to plant and plow under a "green manure" crop, such as alfalfa, to decrease soil bulk density and improve soil structure. Additional tilling would be performed if needed. If soil is severely compacted, scarification would be used to break up the compaction.

A.8.4 Revegetation

All turf, ornamental shrubs, and specialized landscaping would be removed in accordance with landowner's request, or the landowner would be compensated. Restoration work would be performed by personnel familiar with local horticultural and turf establishment practices.

Fertilizer and pH modifiers would be added in accordance with written recommendations obtained from the local soil conservation authority or land management agencies. Any recommended soil pH modifier and fertilizer would be incorporated into the top 2 inches of soil as soon as possible after application.

Seedbeds would be prepared in disturbed areas to a depth of 3 to 4 inches using appropriate equipment to provide a firm seedbed. If hydroseeding is used, seedbed would be scarified to facilitate lodging and germination of seed.

Seeding would be done in accordance with written recommendations from the local soil conservation authority, land management agencies, or other responsible agencies. These recommendations would include seeding mix

ratios, seeding rates, and seeding dates. Private lands could be seeded with alternative mixtures based on landowner's request.

All disturbed soils would be seeded within six working days of final grading if weather permits. If slopes are steeper than 33 percent, seeding would be performed immediately after final grading if weather permits. Temporary erosion control measures would be used at any site where seeding has been delayed.

Where possible, natural seed mixes of local origin would be used along with mulching with no, or low, amounts of fertilizer. Seeds would be applied uniformly and in compliance with recommendations obtained from local soil conservation authorities or land management agencies. For conventional seeding, 4 times the rate of inoculant would be used. For hydroseeding, 10 times the recommended rate of inoculant would be used.

Unless requested by the landowner in writing, seeding and mulching in cultivated cropland would conform with the area adjacent to the right-of-way. If immediate short-term revegetation is needed to help stabilize soils, a cereal grain such as annual rye, oats, or wheat would be drill seeded. Areas with high saline soils or with shallow groundwater tables and more than 6 percent organic matter would not be fertilized. Areas of low precipitation would be covered with mulch prior to seeding.

A.9.0 Post-Construction Activities

A.9.1 Monitoring and Maintenance

Follow-up inspections of all disturbed areas would be conducted after the first and second growing seasons to determine and monitor the success of revegetation and, if required, the need for additional restoration.

Revegetation would be considered successful if visual surveys indicate density and non-nuisance vegetation (or crops in cultivated lands) are similar in intensity and cover to adjacent, undisturbed lands.

Drainage and irrigation systems in agricultural areas would be monitored and corrected if construction causes any adverse effects.

If revegetation is not successful in any area after 2 years, a professional agronomist would determine additional restoration measures.

Routine vegetation maintenance clearing would be done at minimum intervals of 3 years.

Restoration would be considered successful when revegetation is successful, the right-of-way surface condition is similar to surrounding undisturbed land, and all temporary erosion control devices are removed.

A.10.0 Conceptual Riparian Restoration Plan in Upper Diamond Fork Canyon

A.10.1 Introduction

This conceptual restoration plan provides a description of the objectives and methodologies that would be used to restore riparian habitat disturbed by the Proposed Action. A final revegetation plan of the riparian areas would be developed during formulation of the construction specifications for the Proposed Action and during the U.S. Forest Service Special Use Permit.

A.10.2 Description of Disturbance

The riparian zone proposed for disturbance by this alternative is dominated by box elder trees (*Acer negundo* L.) in the majority of the streamside plant communities. Willows (*Salix* spp.) and narrowleaf cottonwood (*Populus angustifolia*) stands are also common along the proposed stretch.

The riparian areas would be disturbed in varying degrees along the 5.1-mile stretch. The degree of disturbance is based on the physical constraints of the proposed corridor. For example, in areas where the canyon is relatively narrow and rock outcrops seriously restrict the work area available for construction, nearly 100 percent of the riparian plant community would be severely disturbed. Other wider portions of the canyon may limit the size of the construction area on only one side of the stream channel. In this case, approximately 50 percent of the riparian community would be disturbed. In other areas, where the road and pipeline could be constructed a distance away from the stream, little or no riparian plants would also be affected. Final engineering design plans would show more precisely the proportions of disturbance for each stretch along the streamside.

A.10.3. Potential for Restoration

Generally, riparian zones provide greater habitat and species diversity than upland areas. Because riparian biotic communities are shaped by natural disturbances (e.g., flooding, fires, ice flows, and herbivory), they can demonstrate high capacities for recovery when disrupted by natural- or man-caused disturbances. Riparian plants must therefore be adapted for establishment, survival, and reproduction in these frequently disturbed areas. Understanding the inherent resilience of riparian vegetation is important for restoration of these ecosystems (Kauffman et al. 1995).

Restoration of riparian habitat is a relatively young field and documentation of attempts is scarce. Several conditions are necessary to ensure a healthy riparian ecosystem, including channel dynamics and geomorphological processes and the growth requirements of the species that occur in riparian systems. Many restoration efforts in the western U.S. have failed in part because of the lack of understanding for establishment of plant species.

Man-made engineering approaches have often focused on in-channel modifications with little recognition of the dynamic interaction between riparian vegetation and the stream channel. Rather than artificial or engineering approaches that attempt to construct riparian and stream channels according to human conceptions, several investigators have suggested more ecological or natural approaches to restoration of these communities (Briggs 1996; Larson 1995; Kauffman et al 1995). Still others recognize the opportunities for enhancement or restoration of riparian ecosystems utilizing natural and/or man-made channel structures (DeBano and Heede 1987).

The potential for dramatic regrowth of riparian species caused by natural flooding in the area should be considered. Sediment deposition caused by the flooding often encourages seed germination and regrowth of riparian species. This flooding can also be destructive to channel structures, bank armor and revegetated streamsides. Therefore, artificial seeding and revegetation efforts may not be necessary for the Diamond Fork drainage. On the other hand, because predicting the potential for natural recovery of the riparian community can be complicated, artificial rehabilitation efforts may insure successful restoration if natural conditions do not provide the appropriate abiotic and biotic factors necessary. Therefore, with "passive restoration" (natural) and "active restoration" (artificial) efforts would be considered for the Diamond Fork drainage system.

Since the causes for disturbance of the riparian communities in the Diamond Fork drainage are straightforward, it is believed that a reclamation and restoration plan can be developed that considers ecological approaches without entirely abandoning selected artificial and natural channel structures.

A.10.4 Pre-Construction and Final Riparian Classification

Riparian Classification

Initial reconnaissance investigations have been conducted to provide preliminary baseline information of the riparian communities along the length of the proposed pipeline corridor. More specific descriptions and data for the riparian communities would be developed prior to construction. Classification of habitats would be conducted using the USDA Forest Service classification system or other appropriate methodologies.

A classification system would also be developed for the riparian communities following construction and restoration. It should be emphasized, however, that due to construction and subsequent maintenance constraints of the pipeline, attempts would not be made to restore the riparian community to the identical community that was classified prior to disturbance. For example, trees and other deep-rooted woody plant species would be discouraged from establishment directly over, and for a given distance away from, the pipeline itself in order to avoid interference with the function and maintenance of the conveyance system.

A.10.5 Pipeline and Tunnel Construction

Soil and Debris Stockpiles

During construction, available topsoil would be stockpiled to be used later in preparation of the final seedbed for revegetation. Some natural debris products (i.e., brush and tree dead fall) would also be saved to be used for temporary river channel structures.

Plant Materials

It is believed that natural seeding from the existing riparian plant species would contribute to the revegetation process through adaptive seed dispersal mechanisms. However, artificial seeding and planting methods would also be employed. Seeds of plant and live plant materials (i.e., trees and willow cuttings) would be used for revegetation of the riparian corridor. Live plant materials from state or private nurseries would also be grown specifically for the Diamond Fork drainage revegetation project.

A.10.6 Restoration

Channel Reconstruction

Straightening stream courses and cutting off meanders can lead to severe down-cutting of channel beds (Larson 1995). The channel would be reconstructed in approximately the same configuration as the natural, predisturbance condition or as near as possible with inherent limitations resulting from the physical constraints of constructing and maintaining a road and pipeline along the stream channel.

Natural and artificial structures (i.e., cienagas, log steps, and check dams that cause sediment deposition) would be placed in the reconstructed stream channel as determined to enhance and develop the riparian plant communities in the revegetation process or chipped and mixed with topsoil.

Bank Protection Structures and Topsoil Placement

Bank protection structures (i.e., bank armor, flow deflection, and separation structures) would be utilized as determined necessary for bank stabilization and riparian vegetation establishment. Topsoil from preserved stockpiles or imported substitute topsoil material would be placed along the reclaimed riparian community.

A.10.7 Revegetation

Soil Amendments and Seeding

Soil sampling would be conducted at regular intervals along the reconstructed streamside. If amendments (i.e., fertilizers) are required, they would be applied to the seedbed prior to seeding. A seed mixture would be prepared using plant species native to the area and mulch (i.e., straw and excelsior matting) would be used as necessary to control erosion, increase moisture infiltration, and decrease desiccation (the seed bed can't evaporate) of the new seedbed.

Limited Access and Use and Noxious Weed Control

Limiting the use by some wildlife (e.g., elk, deer, and moose) would also be considered. Additionally, recreational activities would be restricted until it is determined that the riparian plant communities have achieved final revegetation success.

Noxious weeds would be controlled during the construction period and for at least 5 years following revegetation or until the standards for revegetation success have been met.

A.10.8 Monitoring for Success

Monitoring for revegetation success would be done on a yearly basis for at least 5 years after seeding. Pre-construction baseline data, data taken each year following construction, and pre-determined goals and objectives would be used to assess final revegetation success standards.

Appendix B
Standard Operating Procedures

Appendix B

Standard Operating Procedures

Conduct preconstruction surveys.

Acquire rights-of-way as necessary.

Comply with "Nonpoint Source Water Pollution Control Plan of Hydrologic Modifications in Utah" (designated as the State of Utah's Best Management Practices for nonpoint source water pollution control).

Manage accidental releases of materials into surface waters in accordance with spill containment and countermeasure requirements of the Central Utah Water Conservancy District's construction specifications, including worker education, incident reporting, and remediation provisions.

Inform landowners, land managers, and utilities prior to commencing construction activities.

Brace fences before opening.

Provide for livestock and access control.

Restore fences, gates, and cattle guards.

Restore highways and road surfaces.

Access roads crossing streams and washes would do so at right angles when possible.

Install culverts or other storm water runoff structures when necessary.

Provide dust control measures.

Remove vegetation and obstacles to the extent necessary.

Dispose of debris properly.

Limit grading to that necessary for efficient and safe movement of machinery.

Restore work areas to original contours.

Blasting to be performed in accordance with county, state, and federal regulations.

Store topsoil for revegetation.

Limit length of open trenches to 600 feet.

Excavation area will be security protected at the end of each day.

Adhere to Clean Water Act Section 404 and obtain permit from U.S. Army Corps of Engineers as appropriate for all water crossings.

Schedule road crossings during off-peak traffic hours and cover open trenches with steel plating.

Provide detours as necessary at road crossings.

Protect utilities located in the vicinity of construction.

Provide utilities opportunity to lower depth of buried lines below pipeline.

Compact soils following installation.

Conduct hydrostatic test of pipeline.

Restore disturbed areas as required by the *Erosion Control and Maintenance Plan.*

Restore preconstruction erosion control structures.

Clear debris from right-of-way.

Revegetate tunnel spoil pile.

Appendix C

Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template

Appendix C

Spanish Fork Canyon-Nephi Irrigation System Municipal and Industrial Water System Representative Area Template

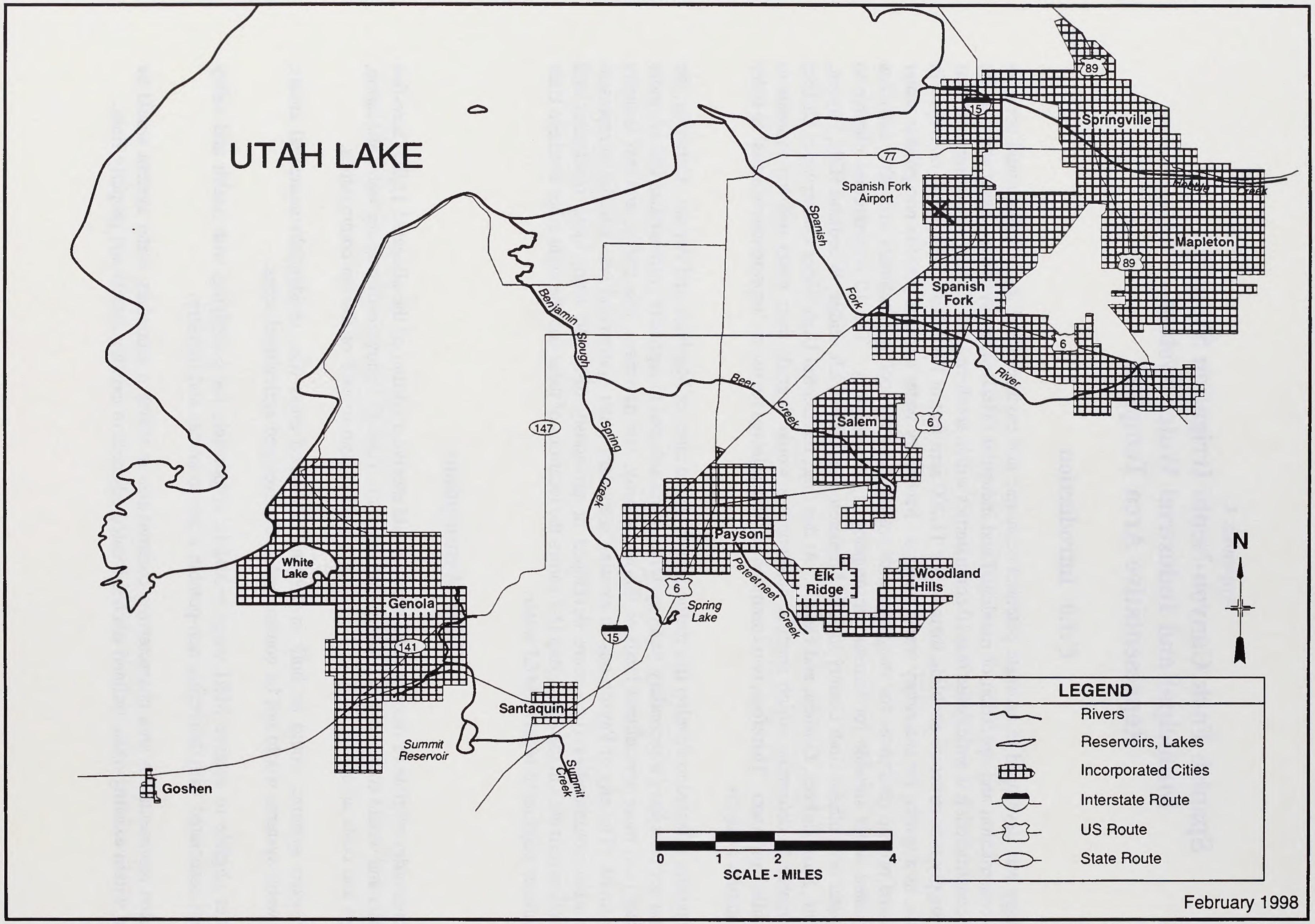
C.1.0 Introduction

This methodology was developed to estimate potential economic and environmental impacts that could occur as a result of the construction and operation of municipal and industrial (M&I) water systems. Assuming that the SFN System is constructed, it is anticipated that 10 communities within southern Utah County would improve their existing water supply infrastructure enabling them to use 11,200 acre-feet of Bonneville Unit water, conveyed in the SFN System, as a source for secondary water systems. Secondary water systems provide non-potable water to commercial and private residences for the purpose of watering lawns, cooling machinery and other activities where using treated water suitable for human consumption is not necessary. The 10 communities eligible to receive M&I water in southern Utah County include Mapleton, Springville, Elk Ridge, Woodland Hills, Payson, Salem, Santaquin, Spanish Fork, Goshen, and Genola. At this time, the Central Utah Water Conservancy District (CUWCD) is unable to determine which specific communities would upgrade their water delivery systems to receive Bonneville Unit water. Therefore, two communities were selected for use as "representative areas" in order to conduct an impact analysis.

The two communities selected to develop this methodology are the cities of Mapleton and Payson. Currently, the city of Mapleton does not have a secondary water system. It was selected to represent communities that are more rural in character (i.e., more agricultural lands or fallow property, less pavement, less traffic, and less industry within the city limit). The city of Payson has an existing secondary water system and was selected to represent the more urbanized communities (i.e., more developed or previously disturbed land, more residences and commercial development etc.) in the area. Map D-1 shows the locations of these and the eight other southern Utah County communities eligible to receive M&I water.

C.2.0 Assumptions

- All 10 communities eligible to receive M&I water would receive a portion of the allocated 11,200 acre-feet of M&I water and would construct a secondary water system. Table C-1 shows estimates for water allocation, worker days and costs associated with constructing a M&I system in each of the ten communities.
- Secondary water systems would be built in existing developed areas (i.e., residential/commercial areas); secondary water systems would not be constructed in undeveloped agricultural areas.
- Communities eligible to receive M&I water would be responsible for complying with health and safety requirements associated with delivering non-potable water to homes and industry.
- The Mapleton representative area characterizes communities in which a secondary water system would be constructed within existing open, unlined ditches located adjacent to existing streets and property lines.



Map C-1
Southern Utah County Communities Eligible to Receive Municipal and Industrial Water

Table C-1
Estimated Factors for Building Secondary Systems in Southern Utah County

	Springville[a]	Spanish Fork[a]	Payson[a]	Salem[b]	Santaquin[a]	Mapleton[b]	Woodland Hills[a]	Elk Ridge[a]	Goshen[a]	Genola[b]	Total
Total Water[c] (AFC)	3,400	2,830	2,300	560	600	890	70	210	150	190	11,200
Acres Serviced (Ac)	1,360	1,132	920	224	240	356	28	84	60	76	4,480
Total Acres (Ac)	6,208	4,864	3,648	640	768	5,888	1,472	1,728	448	8,128	33,792
Work Days[d]	2,483	1,946	1,459	256	307	2,355	589	691	179	3,251	13,517
Labor Costs	$10,200,000	$8,000,000	$6,000,000	$700,000	$1,300,000	$6,500,000	$2,400,000	$2,800,000	$700,000	$13,300,000	$51,900,000
Temporary Disturbance Area (sq ft)	4,700,000	3,900,000	3,200,000	500,000	800,000	800,000	100,000	300,000	200,000	300,000	14,800,000
Disturbed Asphalt (sq ft)	4,800,000	4,000,000	3,200,000	500,000	800,000	800,000	100,000	300,000	200,000	300,000	15,000,000

[a]Payson representative area used.
[b]Mapleton representative area used.
[c]Estimates only, actual amounts may change during contracting process.
[d]Assumes 4 work crews made up of 12 individuals would be employed each day.

- The Payson representative area characterizes similar communities in which secondary water systems would be constructed in existing streets, and that no construction in unlined, open ditches would be required.

- The areas that would be disturbed do not support threatened, endangered, or special status species. In addition, construction of secondary water systems would not occur within any recreation areas or in areas that have mineral and energy resources.

- The maximum width of disturbance along the secondary system alignment would be 15 feet, and all disturbed areas would either be revegetated with upland grasses or landscape plantings, or covered in asphalt/concrete.

- It is estimated that 100 acre-feet of M&I water would serve one 40-acre parcel. Based on the allocated 11,200 acre-feet of M&I water, a total of 112, 40-acre parcels could receive M&I water via a secondary water system.

- The total acreage of land that could be served with M&I water would equal 4,480 acres or 112, 40-acre parcels.

- Of the 10 communities, two (Mapleton and Salem) have a rural character. Based on the estimates provided in Table C-1, the Mapleton representative area represents approximately thirteen percent of potential impacts associated with the development of secondary water systems.

- Of the 10 communities, eight (Springville, Elk Ridge, Woodland Hills, Payson, Santaquin, Spanish Fork, Goshen and Genola) are more urbanized. That is, the Payson representative area represents eighty-seven percent of potential impacts associated with the development of secondary water systems.

C.3.0 Method of Analysis

Within both Mapleton and Payson, a square, forty acre parcel (one-quarter mile section) was selected to represent typical development in each community. Each forty acre square parcel is called a "representative area." The number of homes in each Mapleton and Payson representative area was determined through field review. Figures C-1 and C-2 show the location of streets and homes within the Mapleton and Payson representative area, respectively.

Construction impacts that could occur within a representative area were evaluated in terms of potential impacts to wetlands, wildlife, soils, health and safety, socioeconomics, visual, transportation, and air quality. In performing the impact analysis, both the Mapleton and Payson representatives areas were characterized in terms of existing resources. Total disturbance for each representative area was calculated based on the total length of pipe that would be installed in each representative area, times an assumed work space width of 15 feet. An identified impact in one representative area was then multiplied by the potential number of affected representative areas (112) to determine total potential impacts. Table C-2 shows the total disturbance expected in a representative area, as well as the total expected disturbance associated with the installation of secondary water systems in southern Utah County. The figures are based on the assumptions listed above. An example of how the calculations were computed is listed below.

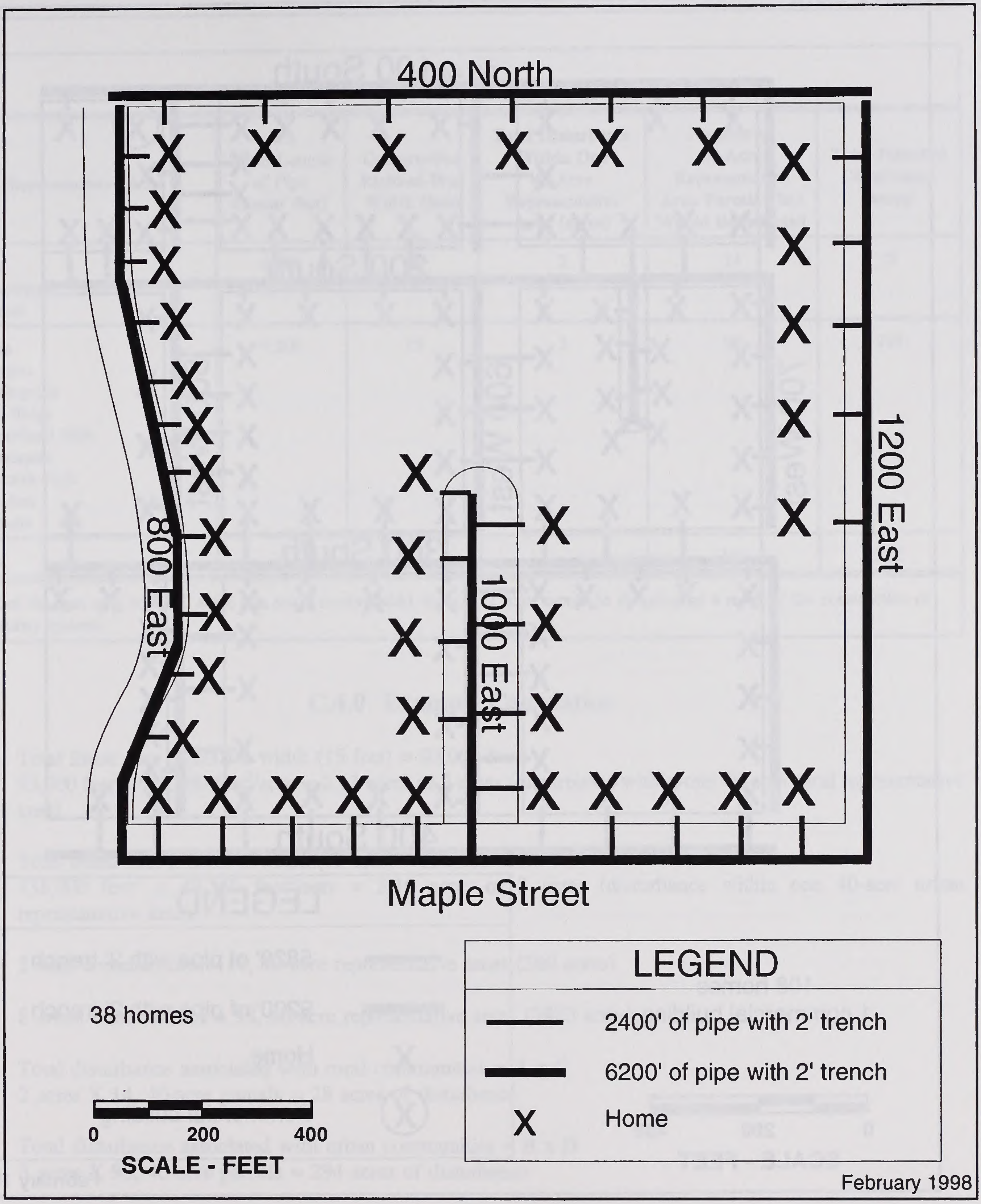


Figure C-1
Mapleton City Representative Area

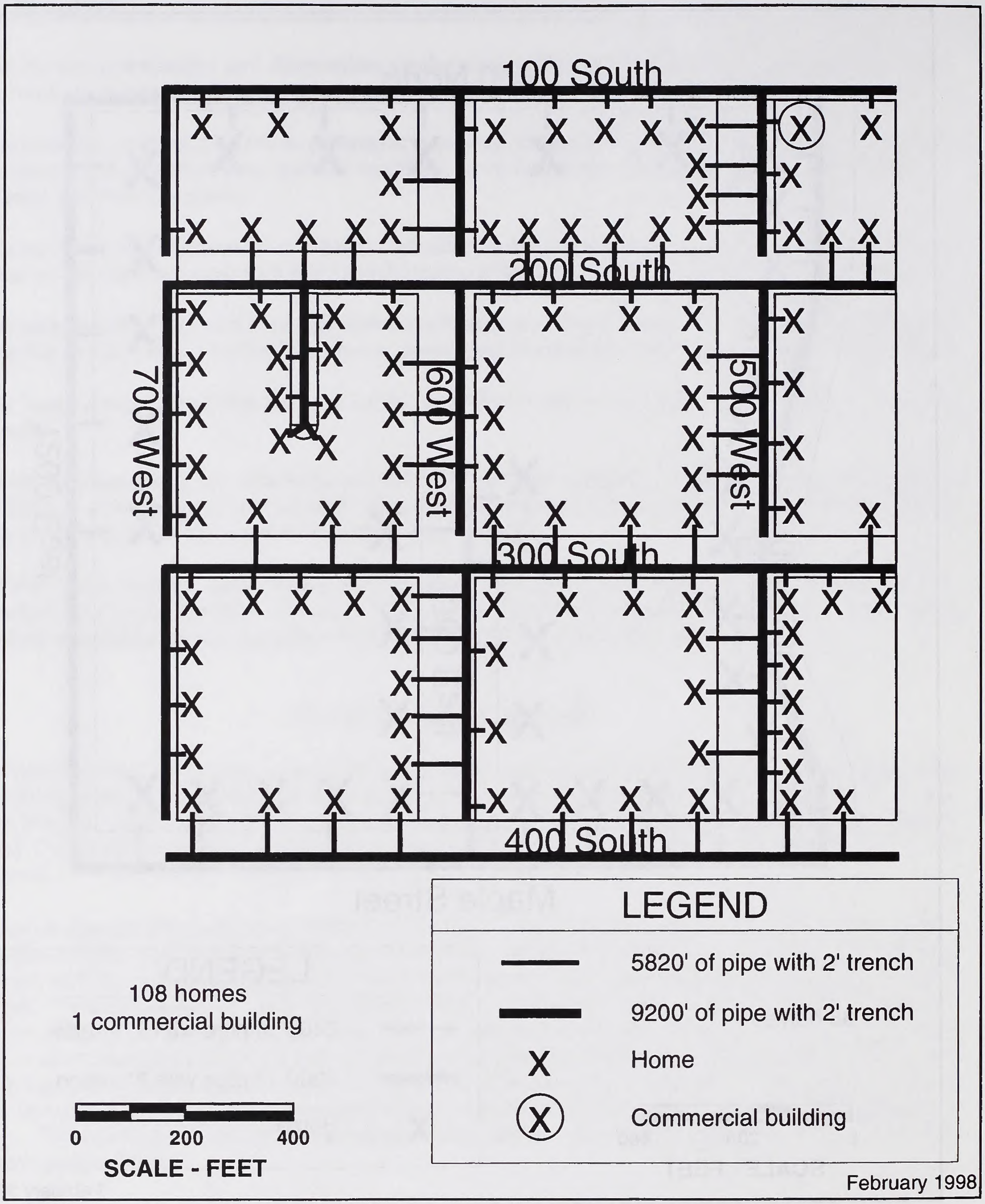


Figure C-2
Payson City Representative Area

Table C-2 Secondary Water System Construction Disturbance					
Representative Area	Total Length of Pipe (linear feet)	Construction Right-of-Way Width (feet)	Total Disturbance Within One 40-Acre Representative Area (acres)	Number of 40-Acre Representative Area Parcels That Would Be Affected	Total Potential Disturbance (acres)
Rural Mapleton Salem	6,200	15	2	14	28
Urban Payson Springville Elk Ridge Woodland Hills Santaquin Spanish Fork Goshen Genola	9,200	15	3	98	294
Total				112	322[1]

[1]Out of the total area of 4,480 acres that could receive M&I water, 322 acres would be disturbed as a result of the construction of secondary systems.

C.4.0 Example Calculation

A) Total linear feet (6,200) x width (15 feet) = 93,000 feet^2
93,000 feet^2 ÷ 43,560 feet^2/acre = 2.13 acres or 2 acres (disturbance within one 40-acre rural representative area).

B) Total linear feet (9,200) x width (15 feet) = 138,000 feet^2
138,000 feet^2 ÷ 43,560 feet^2/acre = 3.16 acres or 3 acres (disturbance within one 40-acre urban representative area).

C) 2 rural communities = 14, 40-acre representative areas (560 acres)

D) 8 urban communities = 98, 40-acre representative areas (3920 acres).

E) Total disturbance associated with rural communities = A x C
2 acres X 14, 40-acre parcels = 28 acres of disturbance

F) Total disturbance associated with urban communities = B x D
3 acres X 98, 40-acre parcels = 294 acres of disturbance

G) Total disturbance associated with M&I System = E + F
294 acres + 28 acres = 322 acres

C.5.0 Construction Costs

Labor: It is estimated that a work crew would be made up of three individuals: one labor foreman, one skilled worker, and one laborer. Using four work crews (12 individuals), it is estimated that it would take 10 work days to complete the installation of a secondary system in one 40 square acre Mapleton representative area, and 16 days in a Payson representative area. The equipment needed to install the system may include trucks, backhoes, front end loaders, vibrating roller or hand compactors, and shovels. Table C-1 provides labor cost estimates for installing secondary systems in the 10 southern Utah communities.

Fees: Current connection costs for the cities of Lehi and Lindon, which have secondary systems, are approximately $200 and $1,000, respectively. The city of Payson, which has an existing system, has a connection cost of $200 and an $8 monthly fee.

Table C-3 shows the estimated costs for the secondary system in the representative areas.

Table C-3
Estimated Fee Costs for Secondary System in Representative Areas (40 acres)

	Mapleton	Payson
Number of Homes and Businesses	38	109
Length of Pipe (feet)	6,200	9,200
Main Line Pipe Costs[1] ($1.59/foot)	$9,858	$14,628
Installation Cost[2] ($4/foot)	$24,800	$36,800
Contingencies (20%)	$4,960	$7,360
Administrative, Engineering, & Legal (15%)	$4,464	$6,624
Total Cost per Representative Area	$44,082	$65,412
Total Cost per Home	$1,160	$600
Total Cost per Acre	$1,100	$1,640

[1]An average pipe diameter of 6 inches was estimated for the main line pipe. This cost estimate includes the cost of pipe and installation.
[2]The service connection cost is the estimated cost of attaching a home to the system, which includes a 1-inch lateral line, the tap to the main line, and a valve.

Appendix D
Contaminant Report Summary Tables

Table D-1
Surface Water Quality Baseline Conditions for Selected Key Contaminants
Water Quality reported in micrograms/liter Biota reported in micrograms/gram of dry weight

			Southern Utah County			Eastern Juab County			
Contaminant	Standard or Guideline	Type of Sample	Diamond Fork Creek	Upper Spanish Fork River	Benjamin Slough	Salt Creek	West Creek	Upper Currant Creek	Lower Currant Creek
Arsenic	190.0 (3+) [a]	Water (mean)	1.0	1.7	7.6	<1	6.0	<1	3.0
	360.0 (3+) [b]	Water (max)	1.0	2.0	17.0	2.0	6.0	2.0	*6.0
	8.0 NOEL, 64.0 PEL [c]	Sediment (mean)			7.0	2.0	no data	2.0	6.0
	1.08 [d]	Fish, fall (mean)	No sediment		1.3			0.6	
	1.08 [d]	Fish, summer (mean)	or biota sampling		1.6	no biota		0.8	
	No guidelines	Invertebrates (mean)	at these locations		7.6	sampling		4.1	
	No guidelines	Bird eggs (mean)			0.3			0.2	
Boron	750 [e]	Water (mean)	26	109	198	72	210	54	90
	750 [e]	Water (max)	60	510	500	460	210	80	110
	No guidelines	Sediment (mean)			100	60	no data	60	120
	No guidelines	Fish, fall (mean)	No sediment		1.5			0.6	
	No guidelines	Fish, summer (mean)	or biota sampling		2.4	no biota		2.9	
	No guidelines	Invertebrates (mean)	at these locations		17.0	sampling		4.1	
	No guidelines	Bird eggs (mean)			1.4			1.5	
Chromium	210 (3+) [a]	Water (mean)	<1	<1	<1	<1	<1	<1	<1
	1,700 (3+) [b]	Water (max)	<1	<1	<1	<1	<1	<1	<5
	33.0 NOEL, 290.0 PEL [c]	Sediment (mean)			9.0	5.0	no data	5.0	6.0
	No guidelines	Fish, fall (mean)	No sediment		1.3			1.2	
	No guidelines	Fish, summer (mean)	or biota sampling		1.6	no biota		1.9	
	No guidelines	Invertebrates (mean)	at these locations		3.1	sampling		1.5	
	No guidelines	Bird eggs (mean)			0.6			0.6	
Copper	12.0 [a]	Water (mean)	<10	<10	<10	<10	<10	<10	<10
	18.0 [b]	Water (max)	<10	<10	<10	<20	<10	<10	<10
	28 NOEL, 170 PEL [c]	Sediment (mean)			10.0	5.0	no data	5.0	30.0
	4.0 [d]	Fish, fall (mean)	No sediment		9.5			5.0	
	4.0 [d]	Fish, summer (mean)	or biota sampling		5.2	no biota		4.9	
	100.0 - 200.0 [f]	Invertebrates (mean)	at these locations		25.0	sampling		72.0	
	No guidelines	Bird eggs (mean)			3.4			3.0	
Mercury	0.012 [a]	Water (mean)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2.400 [b]	Water (max)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	0.15 NOEL, 0.4 PEL [c]	Sediment (mean)			0.03	0.01	no data	0.01	0.02
	0.68 [d]	Fish, fall (mean)	No sediment		0.10			0.10	
	0.68 [d]	Fish, summer (mean)	or biota sampling		ND	no biota		0.30	
	1 - 50 [f]	Invertebrates (mean)	at these locations		ND	sampling		ND	
	No guidelines	Bird eggs (mean)			0.30			0.60	
Lead	3.2 [a]	Water (mean)	<1	<1	<1	<1	<1	<1	<1
	82.0 [b]	Water (max)	<1	<1	<1	<1	<1	<1	<1
	21.0 NOEL,160.0 PEL [c]	Sediment (mean)			30.0	20.0	no data	20.0	40.0
	0.88 [d]	Fish, fall (mean)	No sediment		ND			ND	
	0.88 [d]	Fish, summer (mean)	or biota sampling		ND	no biota		1.80	
	25.0 [f]	Invertebrates (mean)	at these locations		5.3	sampling		ND	
	No guidelines	Bird eggs (mean)			ND			ND	
Total Selenium	5.0 [a]	Water (mean)	<1	<1	1.3	<1	<1	3.7	2.0
	20.0 [b]	Water (max)	2.0	<1	3.0	2.0	<1	4.0	2.0
	2-4, toxic at >4 [g]	Sediment (mean)			<1	<1	no data	<1	<1
	3-6, toxic at >6 [g]	Fish, fall (mean)	No sediment		2.4			3.9	
	3-6, toxic at >6 [g]	Fish, summer (mean)	or biota sampling		3.7	no biota		8.0	
	2-6, toxic at >6 [g]	Invertebrates (mean)	at these locations		5.1	sampling		8.7	
	3-8, toxic at >8 [g]	Bird eggs (mean)			1.8			4.7	
Zinc	110 [a]	Water	<3	<3	<3	<3	<3	<3	<3
	120 [b]	Water (max)	5.0	<10	7.0	20.0	<10	10.0	5.0
	68 NOEL, 300 PEL [c]	Sediment			70.0	20.0	no data	20.0	40.0
	137 [d]	Fish, fall (mean)	No sediment		150.0			118.3	
	137 [d]	Fish, summer (mean)	or biota sampling		141.6	no biota		137.5	
	800 to 2,000 [f]	Invertebrates (mean)	at these locations		142.0	sampling		70.6	
	No guidelines	Bird eggs (mean)			51.1			48.3	

ND = No detection limit
a Utah State Water Quality Standard for 4-day exposure to aquatic life
b Utah State Water Quality Standard for 1-hour exposure to aquatic life
c Guideline only, NOEL (No Observed Effect Level) — PEL (Permissible Exposure Limit) as defined in Table 2-2 (CUWCD, 1997g)
d Guideline only, 85 percentile elevated level as defined in Table 2-3 (CUWCD, 1997g)
e Utah State Water Quality Standard for agricultural use
f Guideline only, Puls "High" as defined in Table 2-4 (CUWCD, 1997g)
g Guideline only, "Level of Concern", toxicity threshold as defined in Table 2-5 (CUWCD, 1997g)

Elevated levels in tissue samples

Table D-2

Surface Water Quality Conditions for Contaminanats Resulting from the Proposed Action MCAPW-DFT, MCATC and MCAP Alternatives [a]

Water Quality reported in micrograms/liter Biota reported in micrograms/gram of dry weight

Contaminant [b]	Type of Sample	Value and Change from Baseline	Southern Utah County			Eastern Juab County			
			Diamond Fork Creek	Upper Spanish Fork River	Benjamin Slough	Salt Creek	West Creek	Upper Currant Creek	Lower Currant Creek
Arsenic	Water	Mean Value	0.7	1.1	7.6	<1	6.7	<1	2.8
		Maximum Value	0.7	1.4	17.0	nm	6.7	4.0	5.8
		Change	-0.3	-0.6	nm	nm	0.7	1	-0.2
	Fish, fall	Value	no biota data collected		1.3	no biota data collected		0.7	
		Change			nm			0.1	
	Fish, summer	Value			1.6			0.9	
		Change			nm			0.1	
	Invertebrates	Value			7.6			4.5	
		Change			nm			0.4	
	Bird eggs	Value			0.3			0.2	
		Change			nm			nm	
Boron	Water	Mean Value	19	72	198	72	233	60	84
		Maximum Value	53	473	500	460	233	86	104
		Change	-7	-37	nm	nm	23	6	-6
	Fish, fall	Value	no biota data collected		1.5	no biota data collected		0.6	
		Change			nm			nm	
	Fish, summer	Value			2.4			3.3	
		Change			nm			0.4	
	Invertebrates	Value			17			4.5	
		Change			nm			0.4	
	Bird eggs	Value			1.4			1.7	
		Change			nm			0.2	
Copper	Water	Mean Value	<10	<10	<10	<10	<10	<10	<10
		Maximum Value	<10	<10	<10	<10	<10	<10	<10
		Change	D	D	nm	nm	I	I	D
	Fish, fall	Value	no biota data collected		9.5	no biota data collected		5.5	
		Change			nm			0.5	
	Fish, summer	Value			5.2			5.5	
		Change			nm			0.6	
	Invertebrates	Value			25			79.9	
		Change			nm			7.9	
	Bird eggs	Value			3.4			3.4	
		Change			nm			0.4	
Lead	Water	Mean Value	<1	<1	<1	<1	<1	<1	<1
		Maximum Value	<1	<1	<1	<1	<1	<1	<1
		Change	D	D	nm	nm	I	I	D
	Fish, fall	Value	no biota data collected		ND	no biota data collected		ND	
		Change			nm			nm	
	Fish, summer	Value			ND			ND	
		Change			nm			nm	
	Invertebrates	Value			5.3			ND	
		Change			nm			nm	
	Bird eggs	Value			ND			ND	
		Change			nm			nm	
Selenium	Water	Mean Value	<1	<1	1.3	<1	<1	4.1	1.9
		Maximum Value	<2	<1	3.0	<1	<1	4.4	1.9
		Change	D	D	nm	nm	I	0.4	-0.1
	Fish, fall	Value	no biota data collected		2.4	no biota data collected		4.3	
		Change			nm			0.4	
	Fish, summer	Value			3.7			8.9	
		Change			nm			0.9	
	Invertebrates	Value			5.1			9.7	
		Change			nm			1.0	
	Bird eggs	Value			1.8			5.3	
		Change			nm			0.6	
Zinc	Water	Mean Value	<3	<3	<3	<3	<3	<3	<3
		Maximum Value	<3	<3	<3	<3	<3	<3	<3
		Change	D	D	nm	nm	I	I	D
	Fish, fall	Value	no biota data collected		150	no biota data collected		131.3	
		Change			nm			13.0	
	Fish, summer	Value			141.6			152.5	
		Change			nm			15.0	
	Invertebrates	Value			142			78.3	
		Change			nm			7.7	
	Bird eggs	Value			51.1			53.6	
		Change			nm			5.3	

a Also applies to the MCAT and MCAPW Alternatives, except as follows:

Upper Spanish Fork River		Arsenic	Boron
Water	Mean Value	1.4	89
	Maximum Value	1.7	490
	Change	-0.3	-20

I = unquantified increase
D = unquantified decrease
nm = no measurable change
ND = below detection level
[shaded] Elevated levels

b Chromium and Mercury not included in the table because of insigificant changes as a result of project alternatives

Table D-3

Surface Water Quality Conditions for Contaminants Resulting from the No Action Alternatives

Water Quality reported in micrograms/liter Biota reported in micrograms/gram of dry weight

Contaminant [b]	Type of Sample	Value and Change from Baseline	Southern Utah County		
			Diamond Fork Creek	Upper Spanish Fork River	Benjamin Slough
Arsenic	Water	Mean Value	0.8	1.3	7.4
		Maximum Value	0.8	1.6	16.8
		Change	-0.2	-0.4	-0.2
	Fish, fall	Value			1.3
		Change			nm
	Fish, summer	Value			1.5
		Change	no biota data collected		-0.1
	Invertebrates	Value			7.4
		Change			-0.2
	Bird Eggs	Value			0.3
		Change			nm
Boron	Water	Mean Value	20	84	193
		Maximum Value	54	485	495
		Change	-6	-25	-5
	Fish, fall	Value			1.5
		Change			nm
	Fish, summer	Value			2.4
		Change	no biota data collected		nm
	Invertebrates	Value			16.5
		Change			-0.5
	Bird Eggs	Value			1.4
		Change			nm
Copper	Water	Mean Value	<10	<10	<10
		Maximum Value	<10	<10	<10
		Change	D	D	nm
	Fish, fall	Value			9.2
		Change			-0.3
	Fish, summer	Value			5.1
		Change	no biota data collected		-0.1
	Invertebrates	Value			24.3
		Change			-0.7
	Bird eggs	Value			3.3
		Change			-0.1
Lead	Water	Mean Value	<1	<1	<1
		Maximum Value	<1	<1	<1
		Change	D	D	nm
	Fish, fall	Value			ND
		Change			nm
	Fish, summer	Value			ND
		Change	no biota data collected		nm
	Invertebrates	Value			5.2
		Change			-0.1
	Bird eggs	Value			ND
		Change			nm
Selenium	Water	Mean Value	<1	<1	1.3
		Maximum Value	<1	<1	3.0
		Change	D	D	nm
	Fish, fall	Value			2.3
		Change			-0.1
	Fish, summer	Value			3.6
		Change	no biota data collected		-0.1
	Invertebrates	Value			5
		Change			-0.1
	Bird eggs	Value			1.8
		Change			nm
Zinc	Water	Mean Value	<3	<3	<3
		Maximum Value	<3	<3	<3
		Change	D	D	nm
	Fish, fall	Value			146
		Change			-4.0
	Fish, summer	Value			137.9
		Change	no biota data collected		-3.7
	Invertebrates	Value			138.2
		Change			-3.8
	Bird eggs	Value			49.7
		Change			-1.4

a No change from baseline conditions for eastern Juab County
b Chromium and mercury are not included because of insignificant changes resulting from the No Action Alternative
nm = no measurable change
ND = below detection level
D= unquantified decrease

Elevated Levels

Appendix E

Recipients of DEIS

Appendix E
Recipients of DEIS

U.S. Advisory Council on Historic Preservation
U.S. Department of Agriculture
- NRCS–Ecological Services Division
- National Agriculture Library
- Regional Forester, USDA Forest Service

U.S. Army Corps of Engineers
- District Engineer, Sacramento
- Bountiful (Utah) Office

U.S. Department of Commerce–Ecology & Conservation Office
U.S. Department of Energy
- Western Area Power Administration
- Office of Environmental Compliance

U.S. Department of Health & Human Services
- Office of Management Analysis & Systems

U.S. Department of Housing & Urban Development–Environmental Officer
U.S. Department of the Interior
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Mines–Mineral Land Assessment
- Fish & Wildlife Service
  - Branch of Federal Activities
  - Ecological Services
- Geology Survey–Office of Environmental Affairs
- National Park Service
- Bureau of Reclamation
- Natural Resources Library
- Information & Library Services
- Office of the Solicitor
- Environmental Policy & Compliance
- Communications
- Central Utah Project Completion Act Office

U.S. Environmental Protection Agency Region VIII
U.S. Department of Transportation–Secretarial Representative
Library of Congress–Congressional Research Service
Utah Congressional Delegation (Utah and Washington, D.C. offices)
- Orrin Hatch
- Robert Bennett
- Bill Orton
- Jim Hansen
- Enid Greene

General Services Administration (Salt Lake City)
Utah Governor's Office of Planning & Budget
- Resource Development Coordinating Committee

Utah Reclamation Mitigation and Conservation Commission (URMCC)
Utah Department of Natural Resources
- Water Rights

Water Resources
Wildlife Resources
Natural Heritage Program
Utah Department of Transportation
Utah Department of Environmental Quality
Drinking Water
Water Quality
Utah State Historical Society
Utah Geological & Mineral Survey
Office of Legislative Research
State Legislators for Wasatch County
Alarik Myrin
Beverly Evans

LIBRARIES

Brigham Young University–Lee Library
Brigham Young University–Law Library
Southern Utah University Library
Snow College–Phillips Library
University of Utah–Eccles Library
University of Utah–Law Library
University of Utah–Marriott Library
Utah State University–Merrill Library
Utah Valley State College Library
Weber State University Library
Westminster College Library
Utah State Library Commission
Utah State Supreme Court–Law Library
Roosevelt Public Library
Uintah County Library
Wasatch County Library
Weber County Library

NEWS MEDIA

Daily Herald (attn: Jo Zimmerman)
Wasatch Wave (attn: Tom Noffsinger)
Park Record (attn: Nan Chalot)
Deseret News (attn: Karl Cates)
Salt Lake Tribune (attn: Tim Fitzpatrick)

MISCELLANEOUS ORGANIZATIONS

Association of Environmental Advocates
Audubon Society
Audubon Council of Utah
Boy Scouts of America
Brighton Estates Water Company
Canyon Irrigation Company
Charleston Irrigation Company
City of Woodland
Daniel Domestic Water Company
Deep Canyon Irrigation Company

Dry Gulch Irrigation Company
Federation of Fly Fisheries
Heber City
High County Fly Fishers
Intermountain Water Alliance
Island Ditch Irrigation Company
Las Vegas Valley Water District
Little Cottonwood–Tanner Ditch Company
Los Angeles Water Department
Metropolitan Water District of Salt Lake City
Mountainland Association of Governments
National Parks & Conservation Association
Nebo Soil Conservation District
North Jordan Irrigation Company
Orem City Water Department
Payson City
Provo City
Provo Parks & Recreation
Provo River Water Users Association
Salt Lake County Fish & Game Association
Salt Lake Teachers Association
Sandy City
SIA Club
Salt Lake County Water Conservancy District
Salt Lake City Department of Public Utilities
South Kamas Irrigation Company
Spanish Fork South Irrigation Company
Wasatch County Special Service Area
Stonefly Society
SUMA Utah Trout Federation
Timpanogos Irrigation Company
UAMPS
Uinta National Forest
Utah State University Cooperative Extension Service
Utah Association of Conservation Districts
Utah County
Utah Lake State Park
Utah Outdoor Interests Coordinating Council
Utah Water Resources Council
Utah Wildlife Federation
Wasatch County
Wasatch County Planner
Wasatch County Water Users Association
Washington Irrigation Company
Wasatch Republicans
Wasatch Soil Conservation District
Weber Basin Water Conservancy District
West Union Canal Company
Wilderness Society

PUBLIC HEARINGS REGISTRATION FORM

Hearings to be held May 11 and 12, 1998

Please note: Verbal testimony will be limited to 5 minutes for each individual. In order to be included as part of the hearing record, written testimony must be submitted at the time of one of the hearings. The registration form should be submitted to the Central Utah Water Conservancy District office by May 8, 1998.

Presenter: ______________________________

Address: ______________________________

City, State, Zip: ______________________________

Representing: ______________________________

I wish to appear at the (choose one)

☐ Salt Lake City (May 11 - 6:30 p.m.)
Salt Lake County Commission Chambers
2001 South State Street, Room N1100
Salt Lake City, Utah

☐ Santaquin (May 12 - 6:30 p.m.)
Santaquin City Senior's Center
65 West 100 South
Santaquin, Utah

Spanish Fork Canyon/Nephi Irrigation System public hearing to express my views on the adequacy or accuracy of the Draft Environmental Impact Statement under consideration.

____
Signature

Forms will also be accepted at the door prior to each hearing.

Please mail registration forms to:

Nancy Hardman
Central Utah Water Conservancy District
355 West University Parkway
Orem, UT 84058-7303

Telephone: (801) 226-7187 Fax: (801) 226-7150